Railway Mechanical Engineer

Established 1832

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*Illustrated

APPOINTMENTS OF RAILWAY OFFICERS

*Illustrated

*Illustrated

Railway Mechanical Engineer

Vol. 98 January, 1924 No. 1

Order Your Index Now

Only a sufficient number of indexes for Volume 97 of the *Railway Mechanical Engineer,* which closed with the December issue, will be printed to supply the number of copies specially requested by our subscribers. If you wish to have a copy, order it now, as the order for printing will soon be made up. Address your request to our New York office, 30 Church street.

Winners in Engine Terminal Competition

In our August and September issues, we announced an offer of two prizes of $50 and $35, respectively, for the two best papers on the most constructive suggestions for expediting locomotive movements through the terminal, simplifying inspection repairs and keeping engine failures down during traffic peaks. The first prize has been awarded to E. Gelzer. Mr. Gelzer, at the time he entered the competition, was employed as a locomotive designer by the Illinois Central. He has recently been appointed mechanical engineer of the Chicago, Great Western, an announcement of which appears in the Personal news columns in this issue. He was at one time a roundhouse foreman on the Pennsylvania System, so that his paper is based on practical experience. The second prize winner is F. M. Podruch, roundhouse foreman of the Chicago, St. Paul, Minneapolis & Omaha at Elroy, Wis. The prize-winning articles will appear in early issues.

A Competition—How Do You Prevent Hot Boxes?

Hot boxes constitute one of the most troublesome conditions with which car department officers and foremen have to deal. The service may be running along smoothly with only an occasional delay chargeable to this cause when suddenly it seems as though every car on the road has become infected and, almost without warning, an epidemic is in progress. These epidemics are frequently very difficult to bring under control and a large amount of special attention is devoted to the situation in an effort to discover just which one of several mechanical or human conditions is at fault. Usually the practice adopted as a result of such special studies, which finally cures the epidemic, aims at a tightening up in several of these conditions, all of which, it may be concluded, were contributory. These epidemics suggest that the problem is one not only of finding the causes which are active in these particular cases, but of maintaining permanently the conditions which prevent the causes from arising. If the conditions are mechanical, how can the repair or renewal of the critical parts be insured at the proper time to prevent these destructive accumulations of trouble? If the cause lies in the failure of lubrication, what form of systematic inspection can be made most effective in remedying faulty lubrication before it has reached the point of failure? We believe that our readers generally will be interested in learning of any measures which have been at all successful in effecting a permanent improvement in hot box conditions. We are, therefore, offering a first prize of $50 and a second prize of $35 for the two best papers describing measures which have been successful in effecting a definite and permanent improvement in the hot box situation, and setting forth as specifically as circumstances will permit just what the results have been. The papers should be received at the office of publication, 30 Church street, New York, on or before March 1, 1924. Papers other than the prize winners that are published will be paid for at space rates.

Improvement in Equipment Conditions

One of the outstanding features of railway progress during the year which has just closed was the remarkable improvement effected in the condition of railway motive power and cars. Had it not been for the splendid condition of the equipment during the summer and fall of 1923, American railways could not possibly have handled the heavy traffic which they did handle so expeditiously and efficiently. Credit for the improvement effected in railway equipment conditions must be given in the largest measure to the mechanical department. We wonder, whether the mechanical department men themselves realize how much they actually did accomplish or how far reaching were the results of their work.

The statistics show that on January 1, 1923, the railways had 13,587, or 21.1 per cent, of their locomotives held for repairs requiring over 24 hours, this large number and percentage still reflecting the effects of the shop employees' strike of 1922. On December 1, 1923, the number of locomotives held for repairs requiring over 24 hours had been reduced to 9,755, or but 14.9 per cent. As a result of this, the number of locomotives in serviceable condition on December 1 was 53,764, an increase in available motive power units over last January 1 of practically 5,000. There were at the beginning of 1923, 216,011 freight cars in bad order, or 9.5 per cent of the total cars on line. On December 1, 1923, there were only 155,626 cars in bad order, or but 6.8 per cent. In effect, this meant an increase in available serviceable cars of approximately 60,000. The improvement effected was due to two factors, one of which was the addition of new equipment replacing old, worn out units, and the other the performance of the railway shops and car repair yards. Every mechanical department man knows what he individually accomplished in connection with the work which was done. He is entitled to know also that the mechanical departments as a whole accomplished a result such as even the most optimistic would not have believed possible but a few months ago.

The railways in 1923 handled a record-breaking traffic without car shortage or congestion. There is enough credit for this performance for all departments to share, but the fact remains that the tools with which the work was done were the serviceable cars and locomotives, made so and kept

so by the mechanical department. Expert students of business conditions give the remarkable operating performance of the railways during 1923 great credit. They emphasize the difference which existed between 1923 and our previous record-breaking traffic period of 1920. In 1920 there was congestion, car shortage and delayed freight movement. In that period consignees could not secure their freight shipments with promptitude. As a result they duplicated their orders and manufacturers and distributors—wholesale or retail—were compelled to build up large stocks of raw materials or goods so that they could make deliveries from stock without having to wait indefinite periods for consignments, from which to fill their orders. Capital and credit were tied up in enormous inventories or in shipments on the road. The inflation, of course, could not continue; late in 1920 the boom burst and in 1921 the reaction was so sharp as to give us a severe depression.

As a result of the splendid railway performance in 1923 the contrast between the conditions existing now and those at the end of 1920 is striking, the business experts say. Business was good in 1923; but there was no inflation. There was no need for excess production nor were excess inventories built up. Prompt railway service necessitated no undue call by business men on the banks for credit. Putting two and two together this means, the experts point out, that efficient railway service in 1923 has given us the basis of a prosperous 1924.

If it is true that the splendid operating performance of the railways in 1923 was largely due to the record made by the mechanical departments in the repair of cars and locomotives, this means plainly that they have done this country a great service. We wonder if, as the mechanical officers and men saw the unserviceable equipment reduce in quantity week by week, they realized how far reaching the effect was going to prove.

Engine Terminals and Locomotive Utilization

There is one subject which warrants the earnest attention of railroad mechanical men in January—and every other month of the New Year. It is the present condition of locomotive terminals and the way in which they limit locomotive utilization and consequently railroad net income. While a few of the more recently constructed terminals are large enough and sufficiently well equipped to handle locomotives promptly and economically, this cannot be truthfully said of the majority of over 3,200 enginehouses on Class I railroads in the United States. Many of these were only just large enough to handle the business at a given point when they were built 20 or more years ago, and were long since outgrown. Others never had the required machinery, equipment, or facilities for minimizing labor costs.

The prime essential for the movement of traffic is adequate motive power and since the number of hours that power can be kept in service is inversely proportional to the time required for conditioning it in engine terminals, the importance of terminals and their direct relation to railroad earnings are plain. From the latest statistics available locomotives are in service only an average of eight hours out of 24, and are turned 1.4 times in 24 hours. The results obtainable by improved terminal facilities and in some cases terminal relocation to reduce the time element per engine turned, and the frequency of turning was strongly emphasized by L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul in a paper read before the Western Society of Engineers, March 13, 1923. A striking paragraph quoted from this paper is as follows: "The average cost of turning power is now approximately $6 to $8 per engine turned and the average number of turns is 1.4 per serviceable locomotive day. A revision of facilities that, by reducing the time element of turning, would produce a reduction of 50 cents per engine turned and reduce the frequency of turning 0.1 turning per day (say from 1.4 to 1.3), will accomplish an annual economy on a complement of 2,000 locomotives to the extent of approximately $650,000, an amount which would pay interest at 5 per cent on $13,000,000. Such an appropriation, properly distributed over the system, would provide for a great many time-saving features which, if utilized advantageously, would produce large returns on the investment and at the same time recover many serviceable locomotive hours to revenue service."

In times of peak load, locomotive utilization (service hours), limited by the present lack of terminal facilities, restricts railroad income, and the railroads are at all times subject to excessive terminal labor costs, owing to the deficiency in coal- and ash-handling machinery, enginehouse cranes of various types, machine tools, drop pits, power trucks and many other labor-saving devices. Railroad officers can address themselves to no more important task than a study of present terminal conditions with a view to developing some comprehensive, workable plan for their early improvement.

People Who Live in Glass Houses

"While railroad shops are, as a rule, not as efficient as they should be, there are a few which, in the matter of methods and equipment, stand out as examples to all the rest." This remark by a leading authority in the machine shop industry, brings to our minds the old familiar maxim about "people who live in glass houses should never throw stones." We cannot help but agree that his statement is true, but why limit it to railroad shops? The same thing can very well be said of practically every other industry and such a statement can be substantiated by fair investigation.

The history of industrial engineering shows that its most outstanding successes have been in new plants where it has been able to have its way in the matter of shop layout and in the selection of machine tools. An inspection trip through various manufacturing plants, power stations and other industries revealed that the newer installations had better and more efficient methods than the older plants. This was for the simple reason that new systems and machinery had to be installed and, of course, the latest and best suited were adopted. In some of the older plants inspected, the machine tools and systems in vogue were no better, and in some cases not as good, as the average railroad shop built at about the same time. Everything considered, it was difficult to see any difference between the development of these plants and that of railroad shops built during the same period.

On account of the character of the work usually performed in a railroad shop, industrial engineers, until recently, have been rather wary of tackling the railroad shop problem. Railroad shops have always been placed in the jobbing shop class. Problems of routing material, placing various machine tools on a production basis, the trouble of adapting time studies to repair work and the necessity of complying with government rules and regulations have always appeared as somewhat of a Jonah. However, recent developments in operating conditions, equipment, shop buildings and machine tools, have enabled the railroads to adopt methods of performing work in repair shops that are in many respects unlike, but just as efficient as those used in straight production work.

It is not to be denied that the railroads are forging ahead in the adoption of efficient methods in the maintenance of their equipment. This fact is well brought out by reviewing the various articles describing new shops and improved methods of management installed in others, which have been published in the *Railway Mechanical Engineer* during the past year. Where justified, railroads having shops with old

buildings and equipment have purchased new machine tools and other facilities, and by rearrangement have obtained an output that can compare favorably with that which will be found in manufacturing plants of similar age and size. The newer shops are far in advance of anything that has ever been done. Efficiency in methods of doing work in the railroad shop is rapidly developing into a separate and distinct field, a field which is unlike that of straight production work.

It is just as unreasonable to select a modern railroad repair shop and compare it with the manufacturing shop of 20 or 30 years ago, as it is to compare a modern manufacturing shop with an old railroad shop. Like every other industry under the sun, railroad shops are not as efficient as they should be, and, like every other industry, there are also a few that "stand out as examples to all the rest."

Relation of Equipment Design to Maintenance

An unusually heavy volume of traffic was handled by American railways during the year just closed. That this was done without the usual and anticipated congestion and car shortage was due in a large measure to the exceedingly creditable work done by the mechanical departments in reducing the number of cars and locomotives being held for repairs. The carrying out of this most important work required the expenditure of enormous sums of money and absorbed a considerable percentage of the railroad revenues. How much of this expenditure might have been avoided had the question of maintenance been given more careful consideration when the designs were prepared, or had the engineers and draftsmen known more about what parts were liable to failure and why, is something that no one can say with assurance. That the expenses were considerably increased due to such a lack of knowledge or to a failure to take everything into consideration when preparing the designs of locomotives and cars is undoubtedly true. Feeling that the men in the mechanical department, who are actively engaged in keeping cars and locomotives in good operating condition, would be able to offer some valuable suggestions as to changes in design that should tend to reduce wear or failures and thereby lessen the expenditures necessary for keeping rolling stock in a proper condition, the *Railway Mechanical Engineer* announced in the December issue two prizes for the best contributions outlining what had actually been done or what might be done in this direction. There is a very real connection between design and cost of maintenance. Progress always is gained first by recognizing where improvements may be made and then by making them. As this competition closes on February 1, there is not a great deal of time left, but enough for those of you who have practical suggestions to send them in if you do not postpone jotting down your ideas on this ever important subject. Let us have your contribution for the betterment of the service.

Home-made Oil-Burning Equipment Wasteful

In view of the amount of fuel oil used in railroad shops, engine terminals, car repair yards, etc., it is plainly of the utmost importance that it be burned efficiently and this implies the utilization of furnaces, torches, forges and burners of scientifically correct design. The *Railway Mechanical Engineer* has called attention in the past to the wastefulness of the large majority, if not all, home-made equipment of the type referred to because it is made by shop mechanics who have neither the specialized experience nor the facilities which outside manufacturers can bring to bear on the design and construction of oil-burning equipment. All the different manufacturers' equipments do not cost the same nor operate with the same degree of economy, however, and the only fair way is to subject them to comparative tests and buy the one which shows the most economy in conjunction with satisfactory work. (*Within reasonable limits, price should have no bearing on the type of oil-burning equipment selected.*)

In line with these views one progressive railroad has recently tested some home-made oil-burning rivet forges as compared to the best manufacturer's forge which could be obtained and the results showed so plainly the superiority of the latter that this railroad has discontinued the practice of making its own forges and oil-burning equipment. During one of the extended tests the consumption of fuel oil by the manufacturer's forge was only 234 gal. as compared to 520 gal. by the home-made forge and this saving in oil also meant a saving in air which costs money to compress. Moreover, there was a serious question as to the quality of the product turned out by the forge which burned such an excessive amount of fuel.

The facts developed in the tests referred to prove beyond question that in the long run the best oil-burning equipment obtainable is cheapest to operate, and it is doubtful if home-made equipment of this type can ever compete successfully in a fairly conducted comparative test with that made by manufacturers.

Efficient Shop Management

One cannot but be impressed when reading the article in this issue by Frank J. Borer, freight shop foreman of the Central Railroad of New Jersey, which was awarded the first prize in the shop management competition, with the fact that it is a mighty human document. True, he does go into the mechanical details of management, but always from a point of view, which is not far in the background, of developing enthusiasm and a spirit of co-operation among the employees (the word "employee" in this connection being used in its larger sense of comprehending both officers and workers, because they are all employees).

One of the most outstanding developments in the railroad field during the year 1923 has been the growing consciousness on the part of all of the factors involved in railroad management and operation, of the importance of the personnel question. This is reflected, for instance, in the letters which chief executives sent to the Railway Age for publication in its Annual Review Number, extracts of which follow:

C. E. Schaff, president of the Missouri-Kansas-Texas Lines, for instance, said: "I believe the education of employees by means of circulars, magazines, lectures, conferences with their officers on safety and other operating matters, has accomplished much and if continued will further promote harmonious relations between employer and employee."

Ralph Budd, president of the Great Northern, said: "Promoting better understanding by railroad employees is a somewhat different problem, but even more important (than public relations). It can only be accomplished by efforts on the part of individual roads to get and keep the confidence of their employees by explaining points commonly misunderstood and misrepresented, by fair dealing with the employees, and by making an honest effort in each case of complaint to settle the controversy as promptly as possible."

C. H. Markham, president of the Illinois Central, said: "One of the noteworthy items in the achievements of the railroads during the last year has been the betterment of their relations with the public and their employees. Railway executives are coming more and more to look upon these problems as being fully as important as any other phase of railway management. The morale of the railway personnel

is founded upon a knowledge and understanding of the railway situation. Forces are constantly at work to spread false information and create misunderstanding. If allowed to go unchecked, these forces would seriously threaten to undermine the efficiency of the railway service. To meet this situation, to give the officers and employees of the railroads a working knowledge of the facts about their business and to interpret that knowledge to them in a way that will be reflected in loyalty to the railroad and the spirit of railway service, is a task which challenges the managements of American railroads today. It has been well said that the railroads are not only twenty-one billion dollars of invested capital, are not alone the locomotives and cars and roadway and structures and other facilities of the railway plant, but are two million men and women engaged in the operation of this plant provided with these funds. To the end that their work shall be performed efficiently and economically, in a spirit of true service and a striving for the better things of life, there needs to be leadership from the managements, as well as courage and high purpose within the ranks."

J. E. Gorman, president of the Chicago, Rock Island & Pacific, said: "A constant and unremitting attention to all of those things calculated to encourage confidence toward the management on the part of employees, and a spirit of co-operation and teamwork, establishes a basis for public appreciation and support. Adherence to a policy of fair dealing with all employees is necessary. An effort to bring to the attention of employees the facts which are so much in public controversy, and the mutual interest of the employee and the management, will unquestionably be helpful in this direction."

We always associate mechanical engineering with the mechanical department of our railroads, but the question is whether we have sufficiently considered the application of mechanical engineering to this department in its largest sense. For instance, the following is a very generally accepted definition for engineering: "Engineering is the science of controlling the forces and of utilizing the materials of nature for the benefit of men, and *the art of organizing and of directing human activities in connection therewith.*" [The italics are ours.]

Engineers are beginning to recognize the thing that is so aptly brought out by Mr. Borer in his closing paragraph, and that is, that after all, it is the spirit which dominates an organization that is the most important factor in securing enthusiasm and co-operation. The trouble is that clean-cut and frequent demonstration of this spirit must be made on the part of the management. We may have a very high regard and love for a person, but unless that spirit is frequently experienced, or demonstrated in practical ways, it will not be recognized or understood. The management, or representatives of the management, must therefore take pains to make dead-sure that their friendly attitude toward the employees is clearly understood and they must constantly seek ways and means of demonstrating this in practical terms.

Not only must the "weeds of misunderstanding" be cleared away, as suggested by Mr. Borer, but the workers must be considered as individuals and steps must be taken to see that they are given the proper incentives. In this connection it may not be out of place to quote an incident which is recorded in the book on "Science and Common Sense in Working with Men," by Walter Dill Scott and M. H. S. Hayes, published by the Ronald Press Company.

"Incidents can be multiplied indefinitely to point the importance of applying the right incentive. We can go through the whole category of instincts, emotions, sentiments, and habits that are discussed in a text book of social psychology and match the greater part of them with incidents where they functioned as incentives. Let us tell you, for example, a story told by Colonel Johnson, who was connected with that combat division in France which included Sergeant York in its ranks.

"A boy from the mountains appeared in a southern camp during the war. He was a 'conscientious objector.' The procedure for handling these offenders was expressible in the phrase, 'Treat 'em rough.' In fact, the commanding officer in this case said, 'Give him hell.' Under that treatment this mountaineer would in a few days have been sent to Leavenworth as incorrigible. 'Treat 'em rough' worked in many cases for the conscientious objector, but it would not work in this case. Then a new officer was put in charge, one who tried new tactics. He appealed to this conscientious objector on the ground of duty and loyalty. He argued that it was his duty to advance the Kingdom of God on earth and to fight against the enemy of truth, and the red-haired York yielded to that treatment and went to the front. In a single day with his own rifle and revolver he shot 60 officers and privates in the German army and brought home 183 prisoners.

"The motive applied was the motive which appealed in that particular case. A shift of motives changed that man from a criminal to an American idol and one of the greatest heroes of the American army. In industry today we have a lot of trouble-makers, agitators, loafers, people who are not interested in the job, but some of them are as they are because of the treatment they are receiving. There are some who could be converted into Sergeant Yorks of industry if they were handled as wisely."

Is It Really Worth While?

How shall we train the shop apprentice in order to develop him for the best future interests of both himself and the railroad? Can we succeed by treating him in an impersonal way as one of a group, or must we consider his peculiar personal characteristics and make him feel, as an individual, that the railroad business is really worth while and that he can become an important factor in it? These are difficult questions to face. The apprentice problem—or training men for the future—in the mechanical department has been considered, where it has been considered at all, as a more or less incidental matter, except for a very few roads.

Sixteen years ago tremendous and prolonged applause followed the presidential address of J. F. Deems before the Atlantic City convention of the American Railway Master Mechanics' Association. In closing he said: "We have inherited; what shall we bequeath? What shall we leave to aid in solving the problems of the future, many of which may be much more perplexing than those we are called upon to solve today? We may work in brass and steel, and leave the most perfect mechanism; we may develop and improve and evolve methods and practices until nothing more can be desired; we may reach perfection in all these, in mechanism, structure and method, and yet our bequest be a failure and itself a burden unless we provide that which is paramount, which is over and above the sum total of all this, and for which even today events throughout the world are crying aloud—*the man*. A man prepared, experienced, earnest; hopeful and happy; consecrated to his work and ready to the hand of the future. * * * Our own future, and the hope of that larger future which lies beyond, depends on our efforts and our success in providing those who are to help us today, and upon whom at no distant day must fall our duties, our opportunities, our honors and our families. Have we any greater, grander, more sublime obligation than this? Can we justify a pride in our life-work if we fail in this?"

Some splendid things have been done in apprentice training since Mr. Deems made this statement—done, however, on a pitifully small number of roads when we consider the great question at issue. It is doubtful if Mr. McGowan,

the winner of the first prize in the apprentice competition, whose article is published in this issue, ever heard of Mr. Deems' address, but his last sentence, coming from a young man just about to complete his apprenticeship, has almost as strong an appeal in it—"I hope that for the sake of future business and future America, our controlling industry, the railroads, will see the need of an extensive apprentice program."

Is is not high time that those in authority faced up to the situation and took some real forward steps in extending modern apprenticeship training? It is not necessary to experiment or to use untried or questionable methods. A few roads have cleared the path and can point to thoroughly tried out, effective methods which cannot fail if introduced and promoted in the proper spirit. Developments during the past few years have shown more clearly than ever before the need for intelligent, well trained employees and high ideals of organization. The training of apprentices can no longer be regarded as an unimportant or incidental question. It is one of the most vital questions confronting the mechanical department of our railroads today. Now that the executives are awakening to the importance of the personnel question on our railroads, mechanical department officers cannot afford to side-step this question simply because its neglect will not stand out in the current balance sheet with a pointing finger of accusation.

Nobody ever accused John Purcell, of the Santa Fe, of being a theorist or a dreamer. He is eminently practical. He was one of the first to face up to this apprenticeship problem in a serious way. With the support of his management and aided by Frank Thomas, he has aggressively promoted modern, up-to-date apprentice methods for years, and he can well afford to point with pride to the results that are so marked and so evident in the mechanical department of the Santa Fe today. In connection with Mr. McGowan's article we commend the re-reading of the splendid address made by Mr. Purcell at the meeting of the Mechanical Division at Chicago last June. It will be found in the July number of the *Railway Mechanical Engineer*, page 497.

Mr. McGowan's paper bristles with constructive suggestions. Every mechanical department officer who is interested in the future of the railroad business should not fail to read it carefully.

Who is this chap McGowan, and why is he qualified to speak on the apprentice question? He knocked around quite a bit before he settled down to work in the mechanical department. For instance, he worked as a sheet metal trade helper, a carpenter helper, a structural concrete workers' helper, and a laborer in a section gang. Then he tried his hand as an apprentice, serving for a while as a leather worker apprentice, an apprentice in the printer's trade and then for two years on deck, starting as an apprentice seaman. Finally he went to the Atlantic Coast Line as a call boy in the transportation department, then to the shops as a laborer on the scrap pile. The next step was as messenger in the erecting shop and then shortly before his twenty-first birthday, he became a regular apprentice at the machinist trade. He was nearing the completion of his apprenticeship when he entered his article in the contest. While serving as a machinist apprentice he started a correspondence school course in mechanical engineering, and after completing his apprentice course in November he entered the drawing room of the Atlantic Coast Line.

Mr. McGowan is, therefore, pretty well qualified to discuss the apprentice question, and he makes some very pointed and constructive suggestions which are mighty well worth reading. He shows, also, a rather keen appreciation of the human side of this question. If you do not have time to read the whole article, don't neglect to study the two paragraphs in the section entitled, "If We Could Only Get the Boy's Point of View."

What Our Readers Think

The Laborer Can Contribute

TO THE EDITOR:

Your editorial on "The Value of Questions," page 795 of the December issue, contains what I consider one of the best suggestions for bringing out what the employees are thinking about and ascertaining just how many really wish to learn more about their jobs, than anything that I have seen for a long time. But, there is a noticeable exception, between brackets, in the words "Except Laborers."

Why should laborers be thus exempted? There was a time when I too may have been agreeable to this exemption, but after having received the attached letter from one of this class of men, it will be readily seen why this exception is taken to leaving out the laborers. This letter took considerable time to decipher; the original is in my possession, written in pencil on a soiled piece of paper, but nevertheless I consider it a classic. The name of the superintendent of motive power, to whom the letter was addressed in entering the suggestion for a prize of $10 which he had offered for the best suggestion for reducing costs of shop operation during the year, has been changed. The letter refers to a supply of very heavy cane brooms that had been substituted for the usual corn broom that had always hitherto been supplied. I am not prepared to confirm the correctness of figures and savings the laborer quotes, but think this letter makes out a strong case in favor of not exempting them from participation in the Chicago, Burlington & Quincy's bulletins.

OBSERVER.

Mr. Blank,

Supt. Motive Power:

I can't expect to win your good prize because I am only a laboring man and not a mechanical one but just the same I want to see the railroads make all they can.

There is to much talk about railroads being managed wrong and I no this one ain't when you offer a $10.00 prize like you have.

My idea is only in a broom and I can sweep as good as any man I no but with a corn broom it works out like this.

I sweep from the vat to big door in Machine Shop behind pit No. 1 in 3 hours, equals $1.17.

To sweep the same distance with the new kind of heavy broom is 5 hours equals $1.95.

Then you lose 78c. a day.

For the rest of the time I help the machinists.

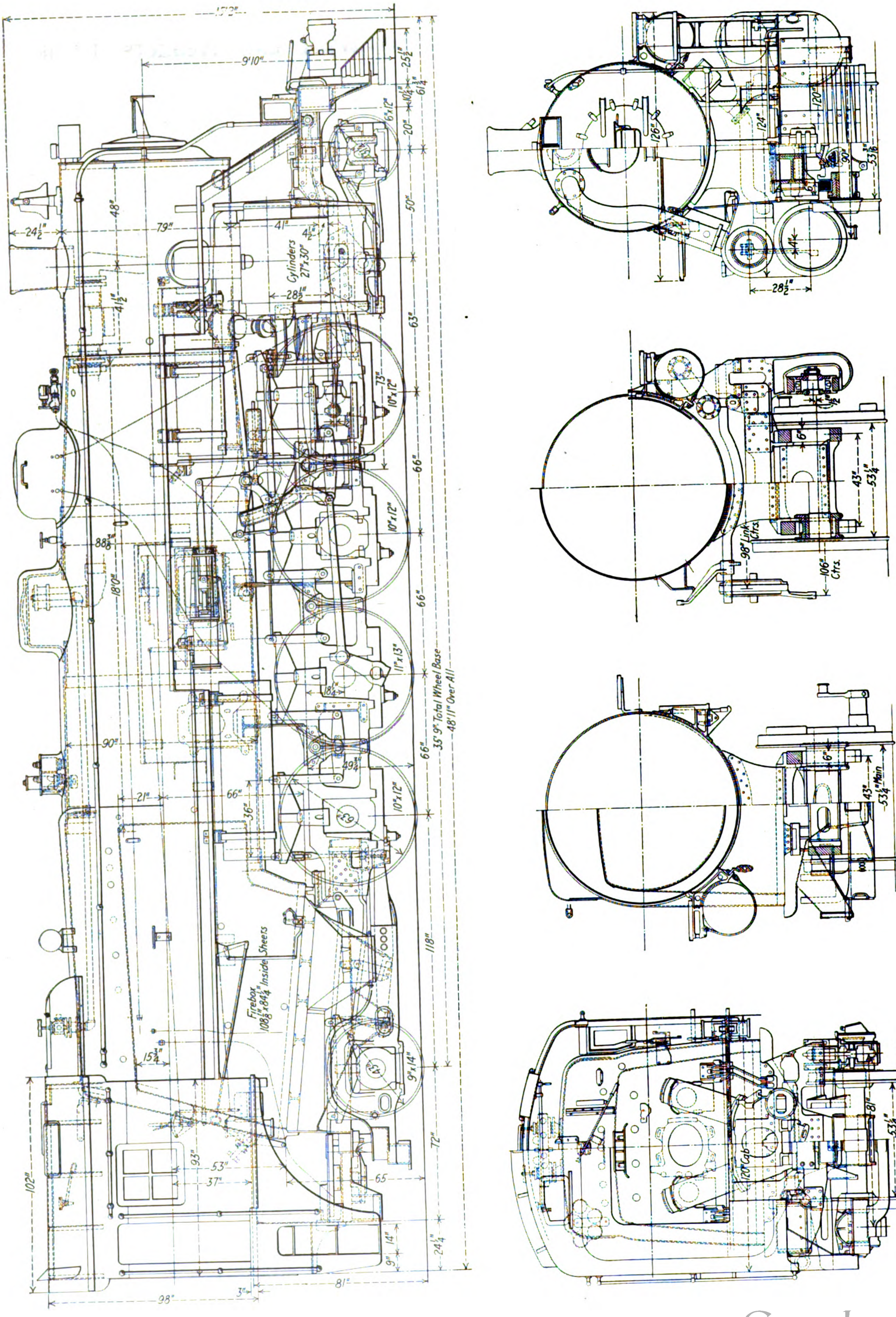
A corn broom lasts about 16 days. This multiplied by 78c. is $12.48 you lose on a hard broom and the hard broom does not last as long.

I have told my boss about these brooms and he says "Do the best you can with them. I do not think they will by any more." Well that is the best I can what I told you about and also your arms about dropp off when you sweep 5 hours with a hard broom and the corn ones do not tire you at all, but I gess they by them hard brooms cheap and they think they make money, but you see how it is, Mr. Blank, don't you? EDWARD G. O'CONNER.

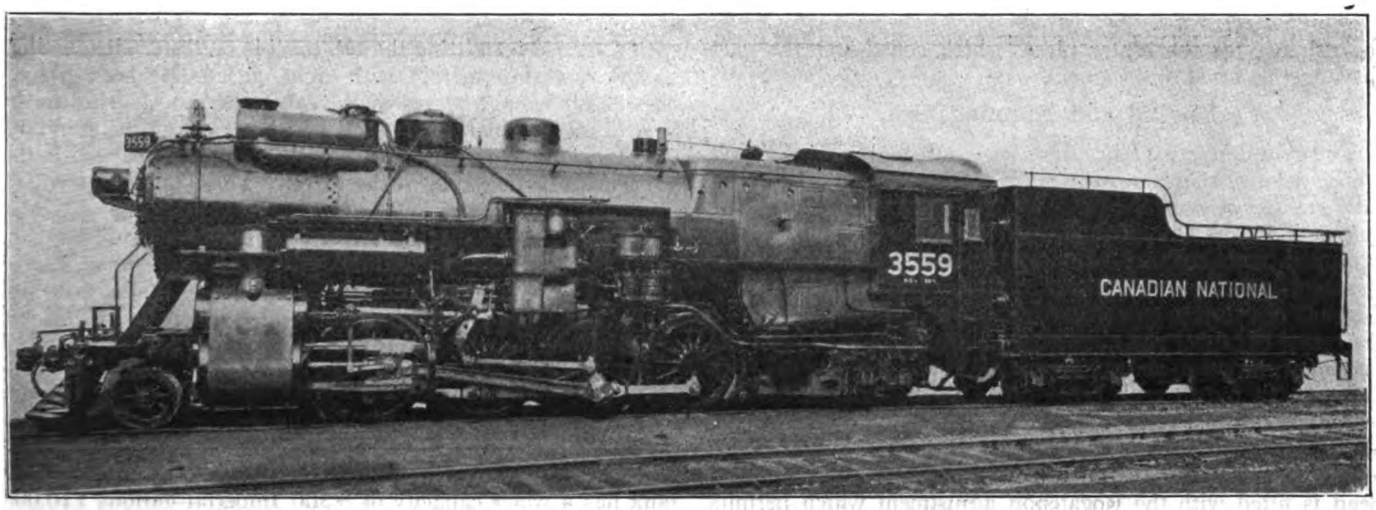
New Books

EMERGENCY BRAKING OF ELECTRIC CARS. *By D. D. Ewing. Bulletin No. 13. Engineering Experiment Station, Purdue University, Lafayette, Ind.* 164 *pages,* 6 *in. by* 9 *in.*

This bulletin contains the report of a series of emergency stop tests made with four types of city and interurban electric cars. The investigation was a co-operative one, participated in by Purdue University, the Central Electric Railway Association and the Westinghouse Traction Brake Company. The manner in which the tests were conducted, the results obtained and the conclusions reached are given in detail.



Cross-Sections and Elevation of Canadian National 2-8-2 Type Locomotive



Canadian National 2-8-2 Type Locomotive with Belpaire Firebox

Canadian National Mikado Type Locomotive

Belpaire Fireboxes and Extended Side Sheets Reduce Troubles from Bad Water in Western Canada

By C. E. Brooks
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WHEN considering the type and design of locomotive to proceed with for handling the increasing traffic of the Western Region, the motive power officers of the Canadian National decided on a Mikado type with a Belpaire boiler as this type of boiler permitted of greater heating surface and steam space. Forty-five of these engines have recently been completed, 35 at the Montreal Locomotive Works and 10 at the Canadian Locomotive Company, Kingston. The locomotives without the booster are classified on the road as S-2-a and are numbered from 3525 to 3559 inclusive. The locomotives with the booster are classified as S-2-b and numbered from 3560 to 3569 inclusive.

A large number of the details used in the construction of these locomotives are also common to the previous order of Mikados and many of the details are common to all Canadian National modern power. The ten engines built at Kingston are identical with those built at Montreal, except for the few changes made necessary on account of the application of the booster to these engines.

The Boiler and Accessories

The boiler is designed with a Belpaire firebox and extended wagon top and conical bottom barrel, the first course being 78 in. and the largest course 90 in. in outside diameter. The firebox proper is 108⅛ in. by 84¼ in. inside and the combustion chamber is 22½ in. long. The boiler horsepower in per cent of cylinder horsepower is 96 per cent.

There are 240, 2-in. tubes and 40, 5⅜-in. flues, 18 ft. 0 in. long; the flues are electrically welded into the back tube sheet according to Canadian National standard practice.

The railway company's standard method of crown staying has been carried out on these boilers and is similar to what was described in a previous article on the Mountain type locomotives.*

The fireboxes are provided with what is known as extruded side sheets. This form of side sheet is being developed on the Canadian National in an effort to overcome troubles due to bad water. With the ordinary flat side sheet, any hammering of the staybolts has a tendency to open up the sheet around the thread of the stay until eventually nothing but the bat head of the stay is holding the sheet. The extruded sheet referred to is so arranged that any hammering of the stays will close the sheet in onto the thread.

These locomotives have been equipped with Duplex stokers and the feedwater supply to the boiler is by means of a Worthington feedwater heater and pump on the left side and that on the right is supplied by a Hancock type E. A. inspirator equipped with 3,500-gal. tubes.

The grates are of Canadian National standard design, the rocking grate bars being of alloy cast steel with detachable lugs. They are operated by Franklin power grate shakers. The ash pans are the Canadian National standard hopper type, the location of the hinges being such that the doors close of their own weight. It was feared that on account of the flatness of the ash pan, owing to the application of the Delta trailing truck frame in connection with the booster, that the grates would be liable to burn out quickly and, in order to overcome this possibility, an auxiliary hopper has been placed on each side of the ash pan, outside of the trailing truck frame. These auxiliary hoppers greatly facilitate the cleaning of the pan and prevent the collection of cinders on the coping.

The ash pans are also equipped with a sludge ejector which consists of a 1¼-in. pipe from the delivery pipe of the inspirator to the ash pans, with a branch extending into each hopper and a valve operated from the cab. The arrangement is specially valuable as it permits the direction of hot water into the pans to thaw them out when the locomotives arrive at a terminal in freezing weather with the pans partly filled.

The superheater, which has 885 sq. ft. of heating surface, is the type A supplied by the Superheater Company and is equipped with forged return bends.

The smoke stack is the railway company's standard three-piece type, the center piece forming the base and fitted to the smokebox, extending down into it. The stack proper and the stack extension fit inside and butt together in the base extension, thus forming protection from the impinging action of

*See *Railway Mechanical Engineer,* August, 1923, page 555.

the exhaust for the center piece, which constitutes the part that must be fitted to the smokebox.

Engine and Running Gear

The cylinders are 27-in. diameter by 30-in. stroke; driving wheels 63-in. diameter with 56-in. cast steel centers; boiler pressure 185 lb. and the rated tractive force 54,600 lb. The cylinders follow Canadian National standard design, being equipped with railway standard by-pass valves and four standard cylinder cocks to each cylinder, two being placed at the ends of cylinder barrel in the usual manner, one placed at the center of barrel and connected with a drain pipe from the bottom of the steam chest (this pipe is covered by the cylinder jacket), the fourth cock being piped to the exhaust cavities which are drained from each quarter. All eight cylinder cocks are operated in unison by one set of levers. The cylinders are also equipped with railway standard relief valves. The crosshead is fitted with the Rogatchoff adjustment which permits the adjustment of the shoes to take up wear.

Steam distribution is provided for by a Walschaert valve motion controlled by a power reverse gear and all parts are interchangeable with previous Mikados. The diameter of the piston valve is 14 in. and the setting is as follows: Travel 6½ in.; lap 1 in.; lead ⅛ in.; exhaust clearance 0 in.

The rear end is fitted with a Commonwealth cast steel cradle casting. The trailing truck is of the Commonwealth constant-resistance type with 43-inch diameter wheels.

Cab and Piping

The cab is of the railway company's standard short vestibule type and has many unique features. This type of cab makes it possible to have almost all the short stays in the sides of the firebox out clear of the cab. The few that remain inside are of the F. B. C. flexible type. The cab is securely riveted to the boiler with a 3-in. by 4-in. angle iron around the whole front of the cab and on the boiler and, in order to take care of expansion the cab brackets are provided with a groove permitting the cab to slide on the cradle casting.

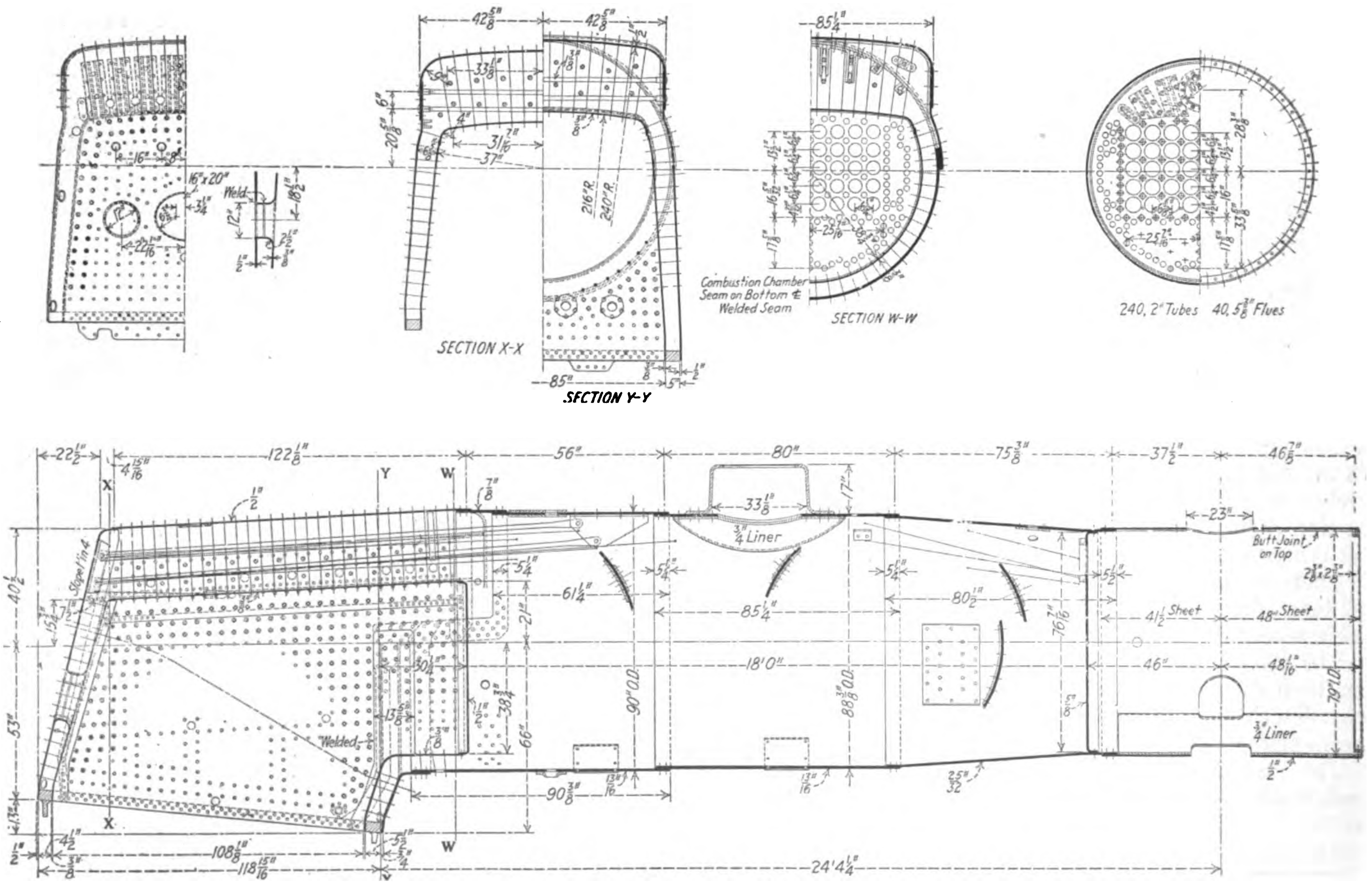
The cast steel turret* with eight outlets has been placed outside far enough ahead of the cab to permit of grinding in or packing the operating valves which are all of one standard size entering the turret horizontally from the rear with the valve seats at the front of the turret. These operating valves are fitted with extension handles carried into the cab and labeled. Not only has the turret been placed outside the cab, but the inspirator, the blower valve and the stoker engine valve as well. Wherever a valve is outside of the cab and under the jacket, a slide has been provided in the jacket directly over the valve so that it is easily accessible.

Other Features

The tank is of the water-bottom type of Canadian National standard design and construction, somewhat modified for the application of the Duplex mechanical stoker. The tank has a water capacity of 8,300 Imperial gallons (10,000 U. S. gallons) and a coal capacity of 12 tons. The tender frame is of the Commonwealth cast steel type. The tender trucks are of the 4-wheel pedestal type equipped with 34¼ in. wheels with semi-steel centers 28 in. in diameter and 6-in. by 11-in. journals, all parts being interchangeable with trucks on previous Mikado locomotives.

The sand box is fitted with Hanlon sanders; World type safety valves are used, three in number, one muffled and two plain. The headlight equipment is made up of a Pyle-National type K-2 turbo generator set and Keystone type No. 1412 cage, fitted with a 14-in. Golden Glow reflector, C. M. S. focusing device and Canadian National standard separate number lamp case with sides oblique, this making for the maximum safety in operation by reason of the easier and more certain identification of locomotive numbers. Water level indication is procured by a Canadian National standard water column welded directly to the back head of the boiler

*For drawing and description see *Railway Mechanical Engineer*, August, 1923, page 555.



The Boiler Is of the Extended Wagon Top and Conical Bottom Type with Belpaire Firebox

and fitted with the railway company's standard try cocks and water glass fittings. The water glass is fitted with a special guard. The steam heat reducing valve is of the World-Leslie type and the piston and valve rod packing is King metallic. Franklin radial buffer and Unit safety bar are used between the engine and tender, and the piping between the engine and tender is equipped with Barco joints. These engines are fitted with Shoemaker firedoors.

The accompanying data table is for the locomotives to which a booster was not applied. The addition of the booster brought the total weight of the engine up to 322,450 lb. and inrceased the total tractive force to 65,000 lb.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian National
Type of locomotive	2-8-2
Service	Freight—Western region
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6½ in.
Outside lap	1 in.
Exhaust clearance	0 in.
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	227,600 lb.
On front truck	29,500 lb.
On trailing truck	57,700 lb.
Total Engine	314,800 lb.
Tender	185,100 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	35 ft. 9 in.
Total engine and tender	68 ft. 10 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	36 in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	11 in. by 13 in.
Driving, others	10½ in. by 12 in.
Front truck	6 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Belpaire, Ext. wagon top
Steam pressure	185 lb.
Fuel, kind and B. t. u.	Bituminous coal
Diameter, first ring, inside	76 7/16 in.
Firebox, length and width	108⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	87 in.
Height mud ring to crown sheet, front	68¼ in.
Arch tubes, number and diameter	4—3 in.
Cumbustion chamber, length	22½ in.
Tubes, number and diameter	240—2 in.
Flues, number and diameter	40—5⅜ in.
Length over tube sheets	18 ft. 0 in.
Grate area	63.26 sq. ft.
Heat surfaces:	
Firebox and comb. chamber	268 sq. ft.
Arch tubes	26 sq. ft.
Tubes	2,249 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,551 sq. ft.
Superheating	885 sq. ft.
Comb. evaporative and superheating	4,436 sq. ft.
Tender:	
Style	Water bottom
Water capacity	8,300 Imp. gal.—10,000 U. S. gal.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 per cent	54,600 lb.
Cylinder horsepower (Cole)	2,427 hp.
Boiler horsepower (Cole) (est.)	2,322 hp.
Speed at 1,000 ft. piston speed	37.5 m. p. h.
Steam required per hour	50,480 lb.
Boiler evaporative capacity per hour	48,300 lb.
Coal required per hour, total	7,890 lb.
Coal rate per sq. ft. grate per hour	123.8 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	72.3
Weight on drivers ÷ tractive force	4.16
Total weight engine ÷ cylinder hp	129.7
Total weight engine ÷ boiler hp	135.5
Total weight engine ÷ comb. heat. surface	71.0
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	95.7
Comb. heat. surface ÷ cylinder hp	1.83
Tractive force ÷ comb. heat. surface	12.31
Tractive force × dia. drivers ÷ comb. heat. surface	775
Cylinder hp. ÷ grate area	38.1
Firebox heat. surface ÷ grate area	4.65
Firebox heat. surface, per cent of evap. heat. surface	8.28
Superheat. surface, per cent of evap. heat. surface	24.92

Are You Numbered Among the Conspirators?*

A Locomotive Fireman Presents the Fuel Wasting Possibilities of Many Practices in a New Light

YOUNG man, if the railroad company has run over your pet cow and won't settle, smashed your automobile when you tried to beat a train to the crossing, or done anything else that makes you feel that blowing up a bridge or burning a string of box cars is the very least that will give you sufficient retaliation, don't do it. It is too crude. Besides, perhaps some of your relatives coming to pay you an unexpected visit may be carried through the damaged bridge. A mail order house may have shipped your order in the very cars you burned. Then, too, you probably will get caught and convicted, with a resultant penalty of two to fourteen years at rock crushing.

Use your gray matter. Do something original. Follow me and I will show you a safer and more efficient method of burning holes in the profits of the railroad, which, I take it, is the ultimate aim of your nefarious ambitions.

Get a job as a locomotive fireman on that railroad. Nobody will get wise to you. They will even help you. Who? Why, most everyone working on that road. Here is a partial list of your partners in crime: Engineers, conductors, brakemen, switchmen, yardmasters, road foremen of engines, trainmasters, car inspectors, air inspectors, fire-up men, roundhouse and shop forces, and last, but not least, the railroad companies themselves. Please bear in mind that you cannot pull off all the following stunts on all railroads, but you can pull most of them on any one you may pick out.

*This is part of one of the papers in the International Railway Fuel Association prize paper contest. It was written by a locomotive fireman whose name has been withheld to protect the writer.

Not knowing of any railroad that is paying extraordinary dividends over any of its competitors, one may infer that they are all burning more fuel than is necessary. I have burned car load after car load of coal which I knew, even before I put it in the firebox, was a waste of my energy as well as a waste of coal, and you can do the same. Even if all the railroad officials in the country should read this and start immediately to block your game, you can get in a lot of deadly work before they can possibly plug all of your opportunities.

Now, let's start. All you need is a good set of teeth, a broad back and to be the first applicant after the extra board gets short. Never mind if you are a misfit, so much the better.

Your first education in handling a scoop will be neglected. Instead of taking you to the cinder pit and fire-up house, have you practice with a scoop on an engine at rest, incidentally teaching you the different depths, sizes and types of the different fireboxes you will use, the way to work injectors and lubricators, etc., they start you out on the road with an older fireman who does not take time to tell you these things. Perhaps he is older by only a few days and is not sure of them himself.

After you have ridden a few miles and still none of these wheels and levers have a familiar look, you feel you must get hold of that scoop or you won't learn a thing on this trip. He lets you put in a fire. He watches you closely to see if he is going to get any assistance out of you. If you try to throw your whole body into the firebox when you throw in a shovelful and all the coal gravitates to the middle

of the firebox and none of it goes to the corners and sides and you just cannot make it go there when he tells you to, your practice for this trip is about over because he takes the scoop before you spoil his fire and make his work harder. The rest of this trip you can learn the road and watch how he does it. You are really taking your second lesson before you have had more than an inkling of the first.

After making three or four round trips, one of which has been tutored by the fireman instructor, you are qualified to begin wasting coal on your own hook. Throw in a bunch of large chunks and then cover them with slack as you would smother a steak with onions. Throw in some more; the engineer will drop her down a few notches and help you burn it out. Not until the water begins to get low in the glass will he advise you to lay off the scoop for a little while. Later on you will find this same engineer helping you burn holes in the company's profits by pet schemes of his own: Carrying water too high, excessive working of the engine, not putting on the injector until after the pop has lifted or even closed again, etc. As you progress in knowledge, you will find other ways that the engineer could, but does not, block your game.

The air inspectors will aid you in their own way. To verify their assistance, wait until your train stops somewhere and then go back and examine that leak. See if the gasket is not hardened—if it has not been worn out for a long time—or if the pipe has not been loose for weeks.

The car inspectors, too, may be relied upon. When taking cars from terminal to gravel pit, stone quarry or coal mine, upon arrival you will find some of them with such large holes in the floor that they cannot be repaired at that point to hold the lading and have to be hauled back in the evening.

The men that fire up locomotives have a bit of aid for you. When you get on your engine, look your fire over. Almost bad enough to require cleaning. Looks like a ton or two and burning green and blue in spots.

Others in the shops are looking out for you, too. The valve setter, for instance. Do you suppose he has a share or two in a coal mine? You will feel confident of it when you get an engine that has lost one or one and one-half exhausts out of four. Don't try to get entirely even on this trip. You will get another chance at her later. She has been this way for months.

Then there are the fellows that fix steam leaks. Your engineer reports the piston rod packing blowing. Next trip you have new piston rod packing rings and swab. Foiled? Not long. In a few days it's leaking again. He did not take time to close the guides and the crosshead is oscillating like the cylinders of a logging engine. It takes them a half a day or so to close these guides, where a couple of hours should be enough. That is why she did not get a lasting repair. When it commences to leak again, you won't mind the pound so much.

Perhaps you have already heard from the gentlemen that are supposed to keep the cylinder and valve packing rings tight.

Your never failing helpers are the air sanders and the men that are supposed to see that they work. Sand, you know, was put on an engine to save coal. Doesn't sound good to you? Do not knock the sanders off or plug them with waste. While working beautifully in dry weather or when emerging from the roundhouse, they are not apt to interfere with your plans when it rains and they are most needed. Sometimes it is a stone jammed into the air nozzle, but more often it is moisture—either condensation at the lower end of the pipe or water carried over from the main reservoir. Other times rain has gotten by the gaskets in the sander proper. The sand pipe may be too short or is not in line with the rail. Ever notice how insecurely they are put on in the first place?

This trip they are working nicely. Not much slipping today. Still you are very apt to run out before you reach a new supply. When you arrive at the coal wharf which is located between terminals, you are told that the supply has run out. On the other hand, there may be plenty of sand but you cannot get any because sparrows have built a nest in the supply pipe and sand will not pass out. The railroad is going to pay another installment on that cow during the remainder of the trip.

The operator or the interlocking towerman is occasionally a good fellow and supports you in your role of villain. After your train has stopped because the signals are set against you, go up and see if he is asleep. He will hear you coming up the steps and proceed to give you an excuse, which later on you find to be without foundation. Then, too, there is the distant signal that he has always set against you. In bad weather after your train has slowed up only to find that everything at the tower is clear and you start to pick up speed again, just credit him with the extra coal. You know from past experience that had it been clear, either he was laying off or there were some railroad officers at his tower, possibly with a trap for you.

Now for some others. Perhaps you would say the railroads themselves. Take the equipment and tools furnished —the small indistinct or black-faced steam gage, for instance. At night, after looking into that nice white fire, you look at the gage to see if your steam pressure is rising or falling. You can not tell, and just to make sure you put in more coal. After a while there is nothing left to do but clean the fire. If there had been two good steam gages the engineer would have been watching his gage closer and you would not have had the nerve to pull this one. A 16-in. gage devoted to 250 lb. steam pressure would speak so loudly to you that you would not have the nerve to let her drop back even if you were thinking of your cow at the time.

Avoid engines equipped with arches and superheaters; also those with two water glasses.

Stick to yard engines and those places where you do not have an individual shovel. The one furnished will probably have a corner gone, cracked at the heel, or a poor handle. This is a dandy chance. Your conscience will charge the waste to the shovel.

In the programming of passenger and freight trains out of terminals, you will find many hours in freight service where you may while away the hours by pumping air, simply because they have the habit of calling you just whenever the train is ready, regardless.

Some morning when you are called to take 10 to 50 empties out to an industrial plant, don't complain because you have a grade to ascend. Bear in mind that these same cars came right down this grade last night, right by the tracks where you are going to put them, but no one had given orders to have them set off. Ten to fifteen extra miles mean quite a bit to your cause in this case, especially if it is the customary thing.

Now, when the road foreman of engines tells you to read up so that you may learn how to save coal—perhaps he will not take steps for years to find out whether you have or not —you will find a great deal of matter relative to nozzles and the back pressure due to them. They will tell you a great deal relative to sizes, describe variable nozzles and automatic nozzles and how much coal is used in making draft.

This is a valuable aid to you and one that will be with you for some time. They have been so busy figuring sizes and effects that it does not seem to have entered their heads that there might be another way of getting around the difficulty. There is another way, and when it is developed the question, "What is the effect of back pressure due to nozzles?" will be left out of your examination papers. But surely, young man, you have wasted enough coal by this time to have given you full and complete satisfaction for the loss of a whole herd of full-blooded, registered, pet cows.

Practical Suggestions As To Apprenticeship

Those in Charge Do Not Recognize the Boy's Point of View and Underestimate His Ability

First Prize*

By. W. L. McGowan
Machinist Apprentice, Atlantic Coast Line, Wilmington, N. C.

OFTEN we have heard an apprentice say, "Tomorrow is my last day, and if the company doesn't keep me I will have a time getting a job elsewhere."

Why? There are many reasons. For instance, he may have been rushed from one job to another, or was kept on one job so long that he could not get all the experience necessary to be an all around mechanic, the result being that he is more of a specialist than a mechanic. Or perhaps he did a lot of detail work, such as threading or putting in bolts and studs, or roughing down work for the real mechanic to finish.

The Neglected Apprentice

Or, by chance, he was put on an assembling job with a narrow-minded mechanic who only allowed him to put in the bolts and cotters. If the apprentice happens not to be quick to understand, in nine cases out of ten if he should happen to ask, "Why do you do it this way, or that?" he will get a sarcastic answer, mingled with profanity, with a "Hand me that wrench," at the end of it. After that he doesn't ask any more, but loafs when sent on an errand. On the other hand, if the mechanic had shown a willingness to give the apprentice the benefit of his experience, the boy would have rushed for the material in order not to miss anything of importance.

W. L. McGowan

I do not believe that 10 per cent of the mechanics are as bad as the fellow mentioned above, but such men can be found in all lines, and the majority are not much better. The average mechanic thinks that the apprentice system is to protect the trade, but fails to see that he could greatly strengthen it by imparting the best of his knowledge, gained by the years of experience. And so when the last day comes and the apprentice boy checks off the last hour, he has no confidence in himself, and if he can't get a job where he is known, he loafs about many days before he gains the nerve to tell an employer he is an all-around man, and takes a chance.

How many college graduates in mechanical engineering find a position waiting for them, as such, when they finish school? "But the apprentice is an altogether different question," someone will say. So he is, but the majority of mechanics turned out by railroads, as well as private concerns, are nearly as far from being mechanics as a graduate in mechanical engineering is from being a mechanical engineer.

You will notice that I speak as though the apprentice depended entirely upon the mechanic for his knowledge of the trade. In the majority of shops he does; that is, in shops where the company takes little interest in the apprentice. In such cases he is regarded as a necessary evil.

If We Could Only Get the Boy's Point of View

I find that the average apprentice is wide-awake to new experiences and a hard worker when an opportunity to do work which requires skill presents itself. Many times, when machining or assembling a difficult job that required skill, I have worked as hard as a man could work, forgetting the clock and my surroundings, not letting up for anything, not even for a drink of water. I even hated to have the noon whistle blow, and when the whistle sounded for 12:30 was right there with my hand on the lever, or with wrench in hand, ready to start. In the afternoon when quitting time came, I would gladly have worked on for half-time or nothing, just to see the job through and gain the experience. On reaching home I would be like a kid with a new toy, would tell my dad and the folks all about my job, and after turning in at night would be as sleepless as a boy on the night before a picnic. Then, after day came and I had checked in for the day's work, maybe the foreman would come to me and say, "Let George finish that and you come over and run the drill press for the day"—then be forgotten for a week or more on the drill press.

That's what knocks the "pep" out of any ambitious apprentice. In lots of shops they don't regard it as an apprentice system, but a method of employing cheap labor. There are many machines that require little or no skill to operate and do accurate work. It is on these machines that the apprentice learns his trade, while the machines that require mechanical skill are operated by the mechanics. The apprentice has a slim chance of getting one. Nearly all lay-out work is done by the mechanic, and there are some that glory in knowing the art. As for the foremen and assistants, they

*This article was awarded the first prize in the competition for regular apprentices, which closed September 1, 1923. Prize awards were announced in the *Railway Mechanical Engineer* for December, 1923.

are more considerate, but in large shops where there are many apprentices, they haven't the time to instruct each and every one of them. Yet I think that they could give the apprentice more experience by instructing the mechanic to see that the apprentice understands the job, and by giving the apprentice the right to complain if he sees he is not getting the proper instructions.

A Data Book Needed

Very few apprentices know the cutting speeds for drills, reamers and other cutting tools. Of the many apprentices coming through the shop when I did, never did I see one refer to a table of any kind. When the job required the use of a tap, the size of tap drill to use was ascertained from some mechanic, or was guessed at. Therefore many valuable taps were broken, sometimes requiring hours to dig them out of the holes, besides making a bad job when finished. Many drills were burned up or broken, material wasted and time lost. Many machines were put out of commission, belts broken, gears stripped, lives endangered, bones broken, and what not, causing the loss of many hours, and the consequent lowering of production, all for the lack of proper instructions.

I sincerely believe that it would pay all companies to get out a printed data book touching on the theory of cutting tools, giving tables of feeds, cutting speeds, etc., and imparting data pertaining to the various departments, with simple formulas, such as are of daily use to the apprentice. Require each apprentice to have a copy, if you have to sell it on the installment plan. I am confident that many hours would be saved, as well as tools and material. Fewer machines would be underworked or overworked.

The Negro and the Mule

Since expenditures for safety on our railroads are alone running into millions of dollars, don't you think a little could be spent in studying the dangers of each machine, and a little booklet handed to each apprentice on the day he starts his service? A little longer and my apprenticeship will be over. I have learned the dangers of some of the machines just as the negro learned a mule will kick. Don't forget that each machine is new to an apprentice.

Recently Judge Gary of the United States Steel Corporation, said, "The hope of American industry lies in its youth." If so, why doesn't one of America's oldest and greatest industries, the railroads, give the youth a chance?

The Hope of the Railroads

H. A. Frommelt, apprentice supervisor of the Falk Corporation, Milwaukee, had an article in the August number of "Trained Men," published by the International Correspondence Schools, dealing with apprentices. It is said that Mr. Frommelt is recognized as one of the leading experts in the field of apprentice training.

The Falk Corporation recognizes the need for men trained from the ranks to hold the executive positions of tomorrow. I believe that it would do the railroads no harm to look into its methods and profit from them. If such methods had been put in effect at the beginning of the century, what a glorious system of transportation we would have today. Some of those who have departed would have reaped a harvest in dividends. Even now, when the roads are hard-pushed to handle the country's ever growing traffic, we have time to start. It was the lack of skilled labor that put them in the hole, and it will be the same that will keep them there if they don't learn to cultivate their own crop. I believe we could start tomorrow without a cent and save enough daily to keep a good apprenticeship system going.

Pertinent Suggestions

First, we must appoint one or more old mechanics, or young, who understand the theory as well as the practice of the trade. Give him full charge of the boys. Give him a chance to study the situation. He's been through the mill—he knows. Have him classify the machines and erecting jobs and outline a schedule. Have a question box. (The apprentices like to ask questions.) The apprentice can write his question and drop it in the box, and in the course of the day the instructor can call on him and talk with him on the subject.

Have the apprentice serve a short term on bolt threaders, bolt skinners, car wheel boring mills, nut facers, cold saws, polishing wheels, etc. Let him serve a definite length of time on drill presses requiring no set-up of work, tire boring mills, tire turning lathes, special work lathes and turret lathes, boring mills, slotters, shapers and all other machines that turn out the same shape and kind of job over and over.

The apprentice should have extensive instruction on general work, heavy-duty or light lathes, boring mills, slotters, shapers, planers, milling machines, quartering machines, key seaters, broachers, grinders, and all other machines requiring skillful as well as accurate workmanship, and requiring the use of precision instruments.

If there are mechanics on these machines, what difference should that make? Give the mechanic an apprentice when he is preparing the work, laying out and measuring preparatory to laying out. Let the apprentice take notes and ask questions. If notes are taken, have them turned in to the instructor in the form of a report. In this way the apprentice will get experience that he otherwise would miss.

Drafting Experience

Before entering the erecting shop the apprentice should understand working drawings. A term in the drawing office would be proper, provided he is not used as a messenger while there. If it is impossible for all, then it should be given to the ones winning in competitions held especially for this purpose.

From the drawing room the apprentice should go to the erecting shop or roundhouse. In the erecting shop the apprentice ordinarily gets stripping, lining shoes and wedges, filing driving boxes, using the acetylene cutting torch, putting in bolts, cotters, flat keys, tightening up nuts, putting up binders, or putting up anything that has already been prepared by the mechanic. Some get squaring up and setting pops and valves. The apprentice should get plenty of lay-out work in the erecting shop and be allowed to make suggestions.

The apprentice has a good show on bench work, such as crosshead, rod, link motion, throttle and reverse lever benches. The air brake and manufacturing tool room the apprentice seldom has time for, while these could easily be brought in with his machine shop practice. If he does happen to get into these departments he is generally used as a handyman.

In the roundhouse the apprentice gets most of the greasy work, but some good experience. In the pipe shop, boiler shop, electric and car shops you will find the apprentice working under nearly the same conditions as at the machinist trade.

I don't remember ever seeing a boilermaker apprentice present at a big lay-out job. The blacksmith apprentice gets about all that's coming to him in the way of practical experience; the sheet metal apprentice also.

I know that the apprentice, regardless of his trade, is wide awake to new experiences, and his one great ambition is to be a good all-around mechanic, and know how to handle the job by blue print. But this he seldom or never learns while serving his time. For this reason he should be made to check details by the drawing.

I hope that for the sake of future business and future America, our controlling industry, the railroads, will see the need of an extensive apprentice program.

The Manufacture of Railroad Engine Greases

A Discussion of the Materials and Processes Entering Into the Production of These Lubricants

By H. L. Kauffman

DRIVING journal compound and rod cup grease constitute that class of greases known as railroad engine greases. They are both hard greases of the soda soap type. Consequently, their general characteristics and methods of manufacture are the same. These greases are made by the cold saponification of fats with caustic soda in the presence of the proper amount of mineral oil.

No other grease that is made must meet the strenuous service requirements that are demanded of driving journal compound. The lubrication of the driving axle journal is more important than the lubrication of any other part of the locomotive. The driving axle boxes of locomotives support the weight of the boiler and its fittings. The pressures per square inch will vary from 200 lb. to 600 lb., depending upon the size and type of locomotive. Owing to the conditions existing in locomotive practices and design, such as the gage of the track, width of the fire box, and so forth, the driving axle journals are made as short as possible. As a result, their length is approximately the same as their diameter. This condition is not found in stationary practice, because the length of the journals is not limited, and as a result it is general practice to make the bearings twice the diameter of the journal in length. It is therefore evident that with the enormous weight on the driving axle journals, and the high rubbing speeds of the journals of fast locomotives, combined with the reduced bearing area and the resultant increased bearing pressure per square inch, that the lubricating conditions are unusually severe.

On smaller engines not fitted with cellars for using journal grease a suitable cylinder stock is used. On the journals of most locomotives, however, there is a cellar below the driving axle to feed the grease to the journal. The grease is molded to the shape of the cellar and placed on the follower plate. A spring is arranged to push the follower plate upward, thus squeezing the grease through the perforated plate, shaped to the contour of the journal and kept from it at a distance of about 1/8 in. Oil grooves are cut to distribute the grease. There is one hole through which some grease reaches the hub face of the wheel, while another hole is arranged for lubricating the shoes and wedges.

The grease must be exceedingly hard to give good results in service. This is necessary because of the great pressures on the journals and the strong spring pressure in the cellars. With a single packing an engine should make a large number of trips, as the springs are so arranged to feed most of the grease from the cellar with only occasional attention. An advantage of grease lubrication of driving axles lies in the fact that grease resists being squeezed out from between the bearing surfaces, but nevertheless can be forced into the bearings at high speeds. It offers greater frictional resistance at high speeds than oil does, but, in spite of this fact, at low speeds and for starting, the thicker film present reduces the frictional resistance, due to the greater separation of the bearing surfaces. Consequently, there is a reduced tendency for the bearing surfaces to interlock.

Rod cup grease is very similar to driving journal compound, although it usually contains a lower percentage of soda soap. To lubricate the pins on driving wheels, the grease is forced into a 2-in. cylindrical grease cup in the driving shaft, and a screw which just fits this opening is screwed in until it presses on the grease sufficiently hard to force grease in the bearing below. As the bearing warms up soon after starting, the grease begins to soften a little and lubricate the driving pins. As the grease is gradually consumed the screw is given another turn to force the grease down to the pins. At starting, a pressure of 3,000 lb. per sq. in. may be reached, and a hard grease is therefore required. The pressure is intermittent, first on one side of the pin, then on the other, so that the grease has an opportunity to get in between the rubbing surfaces.

What Is Engine Grease?

A description of the methods of manufacture of railroad greases must necessarily include a few statements concerning the basic theories upon which the process depends.

Let us remember that a true grease is one that contains a soap. Railroad engine grease is, in reality, a cylinder stock thickened with soda soap. Soap is made by saponifying a fatty oil with a base such as soda, potash, or lime. Fatty oils are made up almost entirely of heavy fatty acids in combination with glycerine. In general, glycerine holds in combination three molecules of stearic or other fatty acids. Olein, stearin, palmatin and similar compounds make up practically all of the animal and vegetable oils and fats. A fatty oil is a glycerine of the fatty acid. Soap is the compound formed between soda, potash, or other bases and the fatty acids. This breaking up of the oil into glycerine and soap is called saponification. The process of manufacturing railroad engine greases depends upon the fact that a soap is made by saponifying a fatty oil.

Practical experience has shown that railroad greases are just as good as the raw materials with which they are made. If we make the grease by saponifying a poor grade of cake tallow having a high fatty acid content we are not going to be able to control the temperature of the batch as well, nor will the resultant product be as good as could be made by using a hard tallow containing one-tenth the amount of fatty acids.

Likewise, it is important that the caustic soda used is of the highest purity, and contains no great amount of sodium carbonate. Both the fat and the caustic used in the manufacture of this grease should be bought on specifications, and should be examined by the laboratory to see if those specifications are met before the products are used in grease-making. One large manufacturer of railroad greases rejected a shipment of caustic soda when the laboratory found that it contained an appreciable amount of sand and powdered brick. If this caustic had been used in grease-making, the impurities in it, undoubtedly, would have caused serious complaints on the quality of the grease.

The cylinder stocks that are used vary greatly in their characteristics, depending upon the nature of the crude from which they are made. Experience has shown that if two railroad greases are made in exactly the same manner, the one containing a specially treated cylinder stock low in tarry matter, the other an untreated stock relatively high in tar, the grease made with the cylinder stock low in tar content is the one to give the better service in use.

The table shows the tests of the cylinder stocks used in the manufacture of railroad greases that are marketed at the present time.

Approximately 40 per cent of the samples examined contained a Pennsylvania cylinder stock, about 15 per cent were untreated stocks, while the majority of the others were

cylinder stocks from Mid-Continent crude. The average viscosity at 210 deg. F., of the samples examined was 147 seconds.

Methods of Manufacture

The usual method of manufacturing either driving journal compound or rod cup grease, although not the best since there is no provision for a temperature control of the batch, is, approximately, as follows:

A 50-50 solution of caustic soda in water is made by adding to a container equal weights of caustic soda and water. Steam is emitted into the solution for about 10 minutes through a perforated pipe at the bottom of the container, in order to obtain a complete solution. The caustic solution is entirely too hot at this time to be used in making the grease, and for this reason it must be made 24 to 30 hours before the batch is to be started. A float covers the surface of the caustic solution so that there is less chance for the formation of the carbonate of soda by exposure to the air.

The required amount of mineral oil is measured into the kettle, followed by the measured quantity of tallow, or tallow oil, the former being the more generally used. If driving journal compound is being made, graphite is added to the kettle at this point. After the addition of the required amount of tallow, the contents of the kettle are stirred for about 10 minutes before adding the caustic solution in order to thoroughly mix the oil, graphite, and tallow. The caustic solution, cooled to room temperature, is passed through a strainer attached to the outlet end of the pipe into the kettle over approximately a 10-minute period of time. The acids in the tallow react immediately and form enough soap to emulsify the oils. The contents of the kettle are stirred until the grease commences to thicken, varying from 20 minutes to 90 minutes, and are then drawn off into barrels. The drawing temperature by the above procedure may vary from 120 deg. F., to 135 deg. F.

A grease made by the process of manufacture described above, where there is no temperature control, and consequently no possibility of manufacturing consistently uniform batches of grease, will not give as good service as one made in a kettle where it is possible to control the temperature, and where the entire manufacturing process is well regulated. This statement has been proved by actual service tests made by the railroads.

The driving journal compound giving the greatest number of miles of service per pound of grease used in this country at the present time is made according to the following formula:

	Per cent
Hard tallow	39.6
Caustic soda	8.3
Water	8.3
Cylinder stock (including dye)	43.8
	100.0

This grease is made with a very high grade of hard tallow, averaging about 0.8 per cent free fatty acids, and having a low titre test. The mineral oil used is a treated cylinder stock, cut back with heavy red paraffine oil to a viscosity at 210 deg. F., of 140 seconds. The caustic soda used is of the highest purity, and is the best obtainable grade on the market.

The general procedure followed in its manufacture is as follows: In one small kettle, slightly elevated above the main kettle, is placed the required amount of caustic soda and water. The caustic solution is stirred while cooling, and is further cooled by water passing through the jacket of the kettle. Into another slightly elevated kettle is placed the tallow which is melted, and passed through a screen into the main kettle to which the required quantity of cylinder oil has already been added.

Cooling water is passed through the jacket of the main grease kettle. The cylinder oil and tallow are stirred in the kettle at a temperature ranging from 80 deg. F. to 90 deg. F. One manufacturer keeps the temperature of the room in which the grease is made at 80 deg. F., throughout the entire year. The caustic soda solution, also at a temperature of 80 deg. F., to 90 deg. F., is added to the kettle over a 15 minute period, continuing the stirring. The batch is stirred at the rate of 38 to 45 r.p.m. for three hours at as low a temperature as it is possible to maintain by means of the cooling water in the jacket of the kettle. The drawing temperature will vary from 85 deg. F., to 100 deg. F., depending upon the initial temperature of the caustic soda solution and the mixture of cylinder oil and tallow.

The grease is fluid when drawn, but "sets up" hard on standing. The temperature continues to rise after being drawn into barrels due to the reaction between the caustic soda and fat. This reaction is not complete for several days. It proceeds rapidly at first but the caustic combines with the fat less quickly after 95 per cent to 97 per cent has reacted, due to the low temperature of the grease at this stage and the low percentage of free caustic soda. Even in the presence of 2.75 per cent of free caustic, from 2 per cent to 4 per cent of fat remains unsaponified even on standing for months.

By this latter method of manufacture the maximum temperature rise in the barrels does not exceed 175 deg. F.; by the first described method the temperature may reach 208 deg. F. Although greases made by both methods might appear to be the same, and might even analyze the same, it has been proved beyond any doubt by actual service tests on the railroads that, by providing for a temperature control of the manufacturing process, the physical characteristics of the grease are improved to such an extent that the maximum efficiency in road service is obtained.

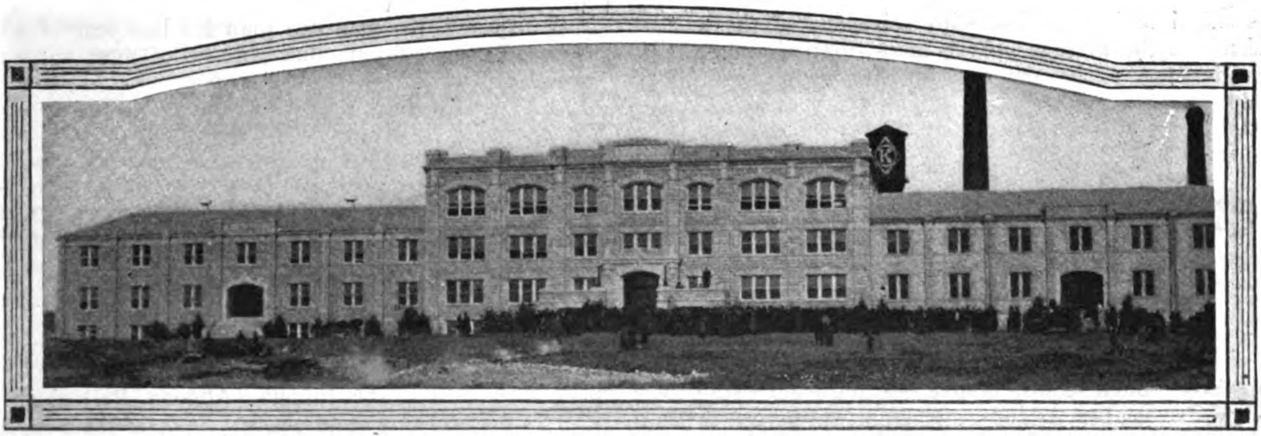
Rod cup grease is made in a manner similar to driving journal compound. The percentage composition, however, is different, and it contains no graphite. Rod cup grease is yellow to yellowish brown in color; driving journal compound of an olive green color due to the graphite or dye which it contains. All railroad engine greases should be "aged" for from 10 days to two weeks before using.

The railroad greases that are marketed in this country at the present time vary in soda soap content from 34 per cent to 54 per cent and in mineral oil content from 22 per cent to 50 per cent. The amount of water present is, in some greases, as high as 19 per cent, while in others it is as low as 7 per cent. A few greases contain no free caustic soda whatsoever, in which case there is present as high as 8 per cent of free fatty oil. Others contain as much as 5 per cent of free caustic, the average being about 2.5 per cent.

In the majority of cases a chemical analysis tells little as to the lubricating value of the grease. A road service test is the only practical method of distinguishing between a good grease and one that has been poorly made.

TESTS OF THE CYLINDER STOCKS USED IN ENGINE GREASES

Sample Number	Gravity	Flash	Fire	Pour	Viscosity at 210 deg. F.	Carbon Residue
		Driving Journal Compound				
1	27.0	515	600	75	144	2.10
2	27.3	520	595	75	133	1.89
3	27.2	...	...	75	104	1.63
4	20.8	...	...	65	146	....
5	25.5	505	585	35	146	4.56
6	26.8	530	600	65	138	1.79
7	27.2	460	540	85	120	1.68
8	26.8	460	540	80	130	1.72
9	22.2	540	600	60	151	2.78
10	20.3	475	535	75	118	....
11	21.4	545	625	65	200	3.76
12	27.0	480	560	60	124	2.49
13	22.0	555	625	50	205	....
14	22.1	420	495	60	136	4.89
15	26.8	520	600	80	114	1.73
16	26.4	510	590	75	133	1.60
17	20.4	535	615	65	177	3.32
18	21.8	530	610	75	196	3.40
19	22.1	475	545	70	143	2.58
20	19.7	460	525	55	196	3.41
		Rod Cup Grease				
1	25.6	520	595	55	133	3.31
2	21.6	475	530	65	125	....
3	20.2	455	520	55	164	4.90



Engineering Building, Kansas State Agricultural College

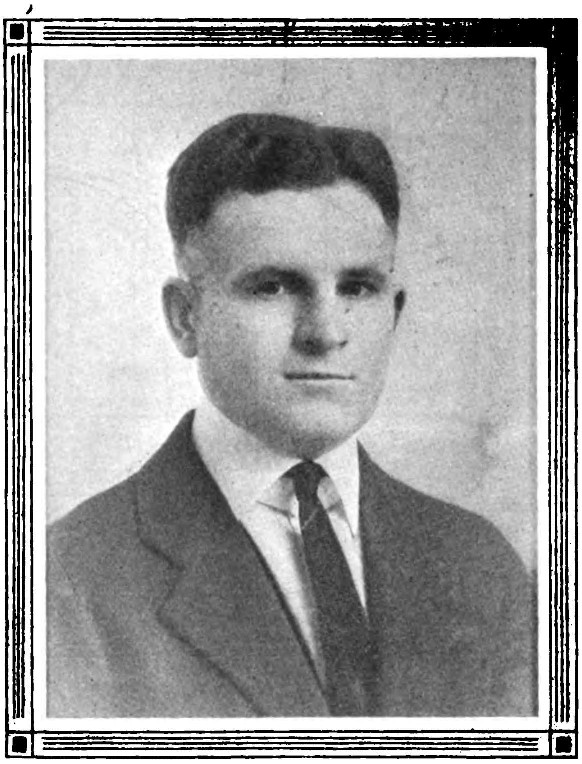
Suggestions as to Special Apprenticeship

The "Special" Should Set a Good Example and Have High Ideals and Aims

Second Prize in Special Apprentice Competition

By Roy Eckart*
Special Apprentice, Atchison, Topeka & Santa Fe, Raton, New Mexico

THE idea of special apprenticeship still needs to be "sold" to both the railroad managements and college graduates. Most college men have the false impression that there is very litle opportunity for advancement, or for the working out of original ideas, in the railroad shop. Happily, some of the far-sighted railroads have commenced to bid against Westinghouse, General Electric, and other large companies, for the services of the technical graduates of our colleges and universities. These graduates advertise the opportunities that they have found to the undergraduates of their Alma Mater, thus securing their interest and giving them an opportunity to prepare themselves for a similar line of work.



Roy Eckart

What is Expected of the College Man

What is expected of the special apprentice? Undoubtedly, the first thing is that which is expected of every man in the service—work. The technical graduate has the challenge to overcome the prejudice that college men are afraid of work, and that they don't like to get their hands dirty.

You are a little older than the regular apprentices, and have had many opportunities that have been denied them. They will, therefore, look to you as an example. Be careful of the example you set. Not only be accurate and thorough in your work, but also keep your character above reproach, for although you may not realize it, you will, because of your training and ability, be the model for some of the younger apprentices and may even be responsible for the shaping of the lives of some of them. Don't be afraid to give the "new kid" a little encouragement and help if he needs it.

Be a dreamer. Let your dream be that by making some improvement in railroading, you are going to do your service to your fellow man. No college graduate should enter the service unless he believes that he can develop an improved method of doing some piece of work, or perfect some piece of apparatus.

Summer Vacations as a Tryout

Since most men taking an engineering course have no definite line of work they expect to follow after graduation, a splendid opportunity is offered to the railroad companies if they will pick a number of third-year men and let them serve in the shops during the summer previous to their graduation.

This is an advantage to both the man and the company—to the man, for he finds out whether or not he likes the work

*Mr. Eckart is a graduate of the Kansas State Agricultural College, Class of 1922. The Special Apprentice Competition closed September 1, 1923.

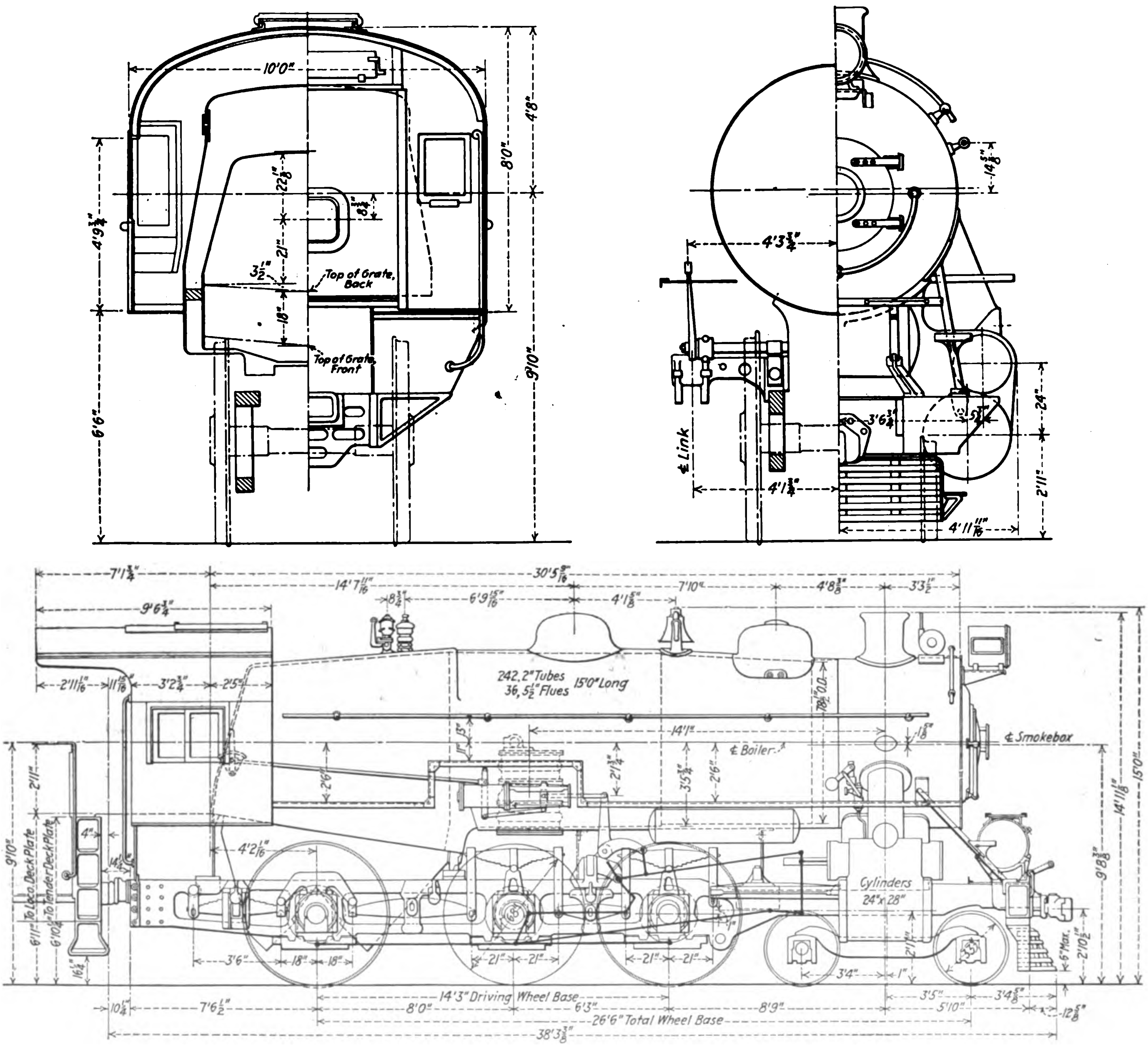
or is suited to it. It also helps solve one of the hardest problems of the average college man—that of finance. It is an advantage to the company, for after seeing the kind of work required, the man can plan his last year of school so as to take the subjects that will be of most value to him in railroad work.

Pennsylvania Ten-Wheel Passenger Locomotive

Class G5s, a New Design for Local Passenger Service with 68-in. Drivers, Develops 41,328-lb. Tractive Force

GRADES often require double heading when using some of the smaller Atlantic and eight-wheel type locomotives in local passenger traffic on the Pennsylvania Railroad System; during the last few years the need for a medium-size locomotive for this service has become urgent. This service requires large tractive effort for quick starting and rapid acceleration to avoid delay in getting trains under way. Tractive effort for this kind of service is of greater importance than high speed.

A ten-wheel locomotive has been designed, of which 40 have been built at the Juniata (Altoona, Pa.) shops of the railroad to meet this requirement. Some of these locomotives are now hauling heavy trains over steep grades on most exacting schedules and the service results amply justify the design. The locomotive has 24-in. by 28-in. cylinders and, with 205 lb. boiler pressure, develops a tractive effort of 41,328 lb. on 68-in. driving wheels. Although not intended primarily for high speed service, the counterbalancing is such that it may safely maintain a speed of 70 miles an hour. This is made possible by the lightness of the reciprocating



Elevation and Cross Sections of Pennsylvania Ten-Wheel Passenger Locomotive, Class G 5s

parts, which weigh 1,008 lb. on one side, or only .425 per cent of the weight of the locomotive. A piston pressure of 92 lb. per pound of reciprocating parts is thus developed.

Boiler

While the locomotive approaches the Pennsylvania K4s Pacific passenger locomotives in starting force, the boiler capacity compares closely with that of the E6s Atlantic type. Although the shell is somewhat shorter, the tubes have been made the same length by building the firebox without a combustion chamber. In certain details, furthermore, interchangeability has been maintained, both for the sake of maintenance and to simplify fabrication. The E6s front end is an example of the former and the use of E6s dies in flanging the heavy barrel sheet connection for the top of the Belpaire firebox is an example of the latter. The outside throat sheet and the lower half of the rear barrel course are flanged in one piece, but owing to the location of the firebox over the rear drivers, the throat is shallower than the E6s boiler.

The internal diameter of the boiler is 76¾ in. at the forward end and 81¾ in. at the dome. This has made possible the insertion of 242 two-in. tubes and 36 five-and-one-half-in. superheater flues, the same as in the E6s boilers. The firebox is 110¼ in. long by 72 in. wide and has a grate area of 55.13 sq. ft. It is equipped with a Security brick arch supported on three 3-in. water tubes. The grate is arranged with a slope of 17.8 per cent towards the front.

A Type A superheater, consisting of 36 units, with a heating surface of 798 sq. ft. is used. The front end is of the self-cleaning type with an inside extension to the smoke stack reaching slightly below the center line of the boiler insuring proper draft through all flues.

Steam Distribution

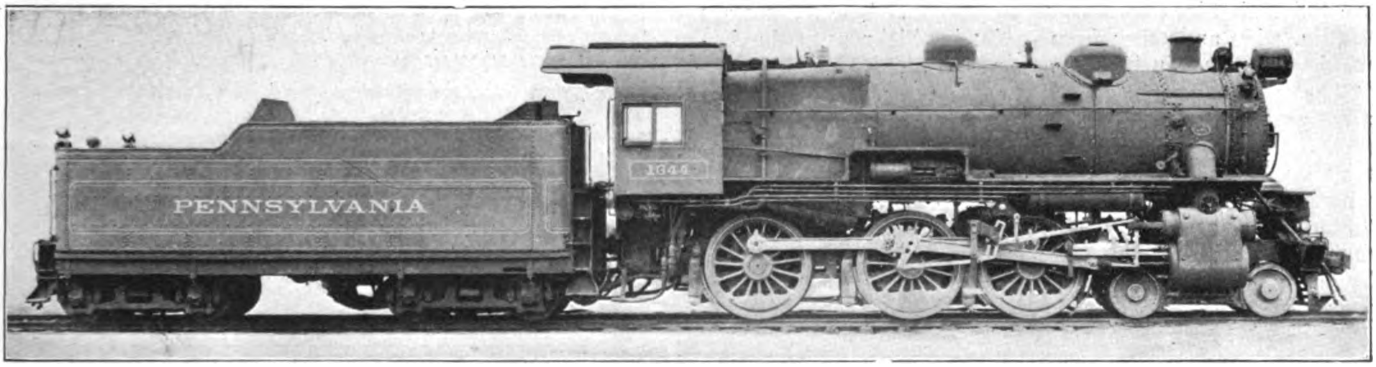
The valve gear is of the Walschaert type with all parts made as light as possible consistent with the strength desired. A standard 12-in. piston valve is used. An air operated power reverse gear has been made standard for this type of locomotive. These designs are equipped with the Alco gear, which is provided with an auxiliary air reservoir and check valve to retain sufficient air for reversing the gear several times, or holding it in place in case the main supply of air fails for any reason.

The throttle is of the floating stem type with drifting attachment, a design which is exceptionally easy to operate and responds instantly to any movement of the throttle lever.

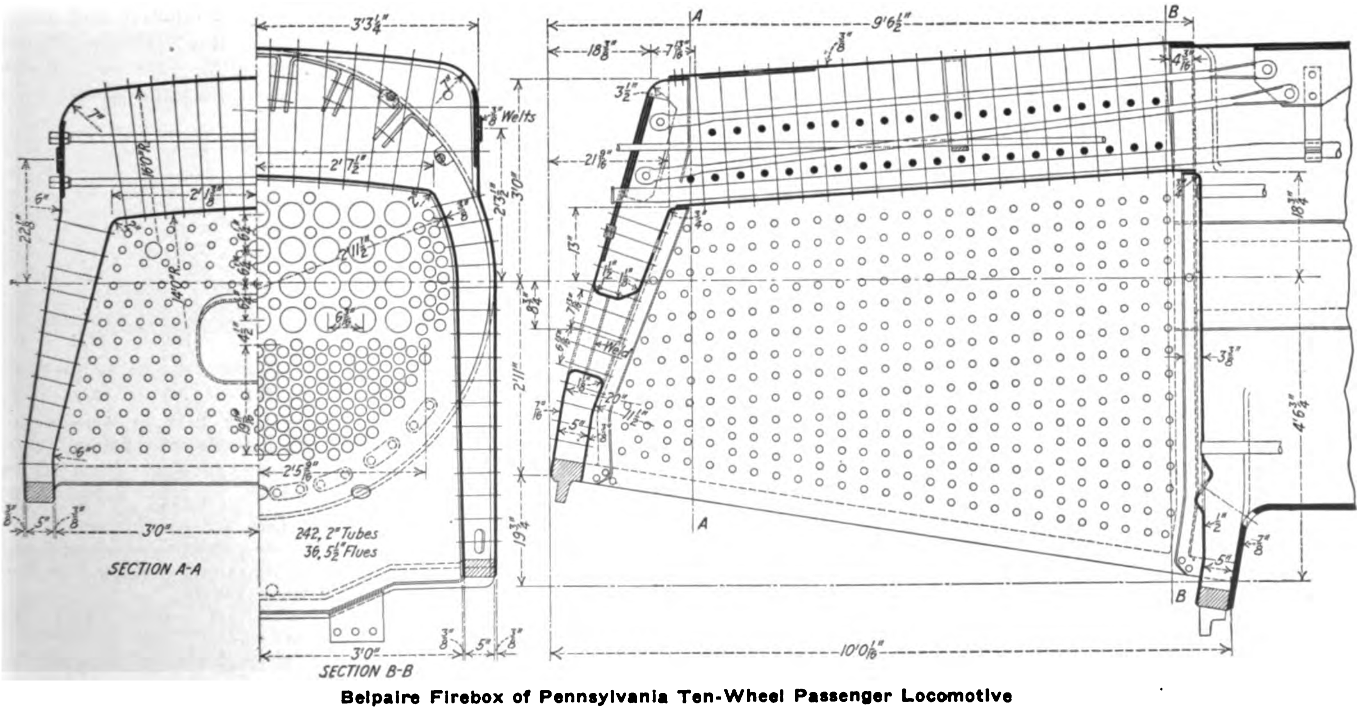
Frames and Running Gear

The frames are of cast steel four inches wide and reinforced to 7⅞ in. over the driving boxes. The driving axles have a 3-in. hole drilled through the center to facilitate their heat treatment. The journals are 9¾ in. by 13 in.

The piston rods on these engines are not of the extended type but are hollow drilled. They are 4 in. in diameter and



New Ten-Wheel Locomotive for Heavy Local Passenger Service



Belpaire Firebox of Pennsylvania Ten-Wheel Passenger Locomotive

have a 2¼-in. hole drilled through the center from end to end. This hole is reduced to 1½ in. at the piston fit and to ¾ in. at the crosshead fit where the ends of the rods are forged down. An important feature in the design of the piston rod is that its length is such as will enable the piston to be pulled out of the front end of the cylinder without cutting the piston rod loose from the crosshead. The piston is made with a rolled steel center and a cast iron bull ring fitted with cast iron piston packing rings.

The main rods are of I-section, 7½ in. deep at the rear end and 7 in. at the front end, with a 5½-in. milled section of the rod maintained throughout the length. The flanges are 4¼ in. wide and taper from ¾ in. in thickness at the forward end to one inch at the rear end.

The crosshead runs on three bar guides and is of exceptionally light construction.

A comparatively large tender is used with these locomotives because of the fact that many of them will be used where track tanks are not available. The water capacity is 7,800 gal. and coal capacity approximately 15 tons. The tanks are carried on four-wheel trucks, the front with 5½-in. by 10-in. journals and the rear will have 6-in. by 11-in. journals.

Table of the Dimensions, Weights and Proportions

Type of locomotive	4-6-0
Service	Passenger
Cylinders, diameter and stroke	24 in. by 28. in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum Travel	7 in.
Outside lap	1 1/16 in.
Weights in working order:	
On drivers	178,000 lb.
On front truck	59,000 lb.
Total engine	237,000 lb.
Tender	176,500 lb.
Wheel bases:	
Driving	14 ft. 3 in.
Total engine	26 ft. 6 in.
Total engine and tender	62 ft. 7¼ in.
Driving wheels, diameter outside tires	68 in.
Boiler:	
Type	Belpaire, wide firebox
Steam pressure	205 lb.
Fuel	Bit. coal
Diameter, first ring inside	76¾ in.
Firebox, length and width	110½ in. by 72 in.
Height to crown sheet, back	48 in.
Height to crown sheet, front	73½ in.
Tubes, number and diameter	242—2 in.
Flues, number and diameter	36—5½ in.
Length between tube sheets	15 ft.
Gas area through tubes and flues	6.92 sq. ft.
Grate area	55.13 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	185 sq. ft.
Tubes and flues	2,677 sq. ft.
Total evaporative	2,862 sq. ft.
Superheating	798 sq. ft.
Comb. evaporative and superheating	3,660 sq. ft.
Tender:	
Water capacity	7,800 gal.
Fuel capacity	29,300 lb.
General data estimated:	
Rated tractive force, 85 per cent	41,328 lb.
Cylinder horsepower (Cole)	2,128 hp.
Speed at 1,000 ft. piston speed	43.3 m. p. h.
Steam requires per hour	44,262 lb.
Coal required per hour	6,916 lb.
Coal rate per sq. ft. grate per hour	125.4 lb.
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp	1.72
Tractive force ÷ comb. heat. surface	11.29
Tractive force × dia. drivers ÷ comb. heat. surface	768
Cylinder hp. ÷ grate area	38.6
Firebox heat. surface, per cent of evap. heat. surface	6.5
Superheat. surface, per cent of evap. heat. surface	27.9
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	75.1
Weight on drivers ÷ tractive force	4.3
Total weight engine ÷ cylinder hp.	111.3

Bureau of Locomotive Inspection Report

Increase in Defects and Accidents as Compared with Excellent Showing of Preceding Year

The twelfth annual report to the Interstate Commerce Commission by A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, for the fiscal year ending June 30, 1923, shows a marked increase in the number of defects and accidents due to the abnormal prevailing conditions. An abstract of the report follows:

The percentage of locomotives found defective increased from 48 per cent during the preceding year to 65 per cent, and the total number of defects increased approximately 70 per cent. The deteriorated condition of motive power is sharply reflected in the increased number of accidents and casualties. A comparison of accidents and casualties during the year as compared with the preceding year shows an increase of 117 per cent in the number of accidents, 118 per cent in the number killed, and 120 per cent in the number injured.

Records covering locomotive failures indicate that the number of locomotive miles per locomotive failure decreased as much as from 50 to 70 per cent during the year as compared with the preceding year. Every locomotive failure caused by physical defects carries with it potential injury to persons, serious delay to traffic, and heavy property damage.

During the year there were 57 boiler explosions which resulted in the death of 41 persons and the serious injury of 88 others, an increase of 75 per cent in the number of such explosions, 86 per cent in the number of persons killed, and 93 per cent in the number injured, as compared with the preceding year. While most of these explosions were caused by the crown sheet having become overheated due to low water, the number of such cases where contributory defects or causes were found increased approximately 135 per cent as compared with the preceding year. The contributory causes found clearly establish the necessity for proper inspection and repair of all parts and appliances of the locomotive and tender.

During the year numerous accidents were investigated where welds made by the fusion or autogenous process were involved. The investigations fully support the position pre-

Locomotives Inspected and Defects Found

	1923	1922	1921	1920
Locomotives reported	70,242	70,070	70,475	69,910
Locomotives inspected	63,657	64,354	60,812	49,471
Locomotives defective	41,150	30,978	30,207	25,529
Percentage inspected found defective	65	48	50	52
Locomotives ordered out of service	7,075	3,089	3,914	3,774

Accidents Caused by the Failure of Some Part or Appurtenance of the Boiler

	1923	1922	1921	1920
Number of accidents	509	273	342	439
Number killed	47	25	51	48
Number injured	594	318	379	503

Accidents Caused by the Failure of Some Part or Appurtenance of the Locomotive and Tender, Including the Boiler

	1923	1922	1921	1920
Number of accidents	1,348	622	735	843
Number killed	72	33	64	66
Number injured	1,560	709	800	916

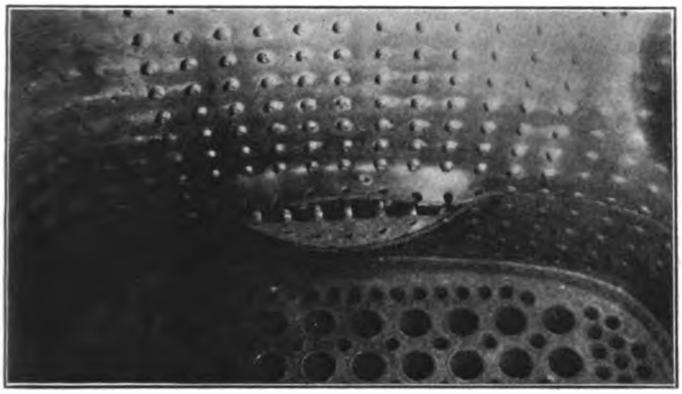
Derailments and Accidents Due to Defects in or Failure of Some Part of the Locomotive or Tender

	1923	1922	1921	1920
Number of derailments*	38	22	8	7
Number killed	4	5	..	7
Number injured	157	61	30	18

* Only derailments reported by carriers as being caused by defect in or failure of parts of the locomotive or tender were investigated or counted.

viously taken that this process has not reached a state of development where it can safely be depended upon in boiler construction and repair where the strain to which the structure is subjected is not carried by other construction, nor in firebox crown sheet seams where overheating and failure are liable to occur, or on any part of the locomotive or tender subject to shock or strain where, through failure, accident and injury might result.

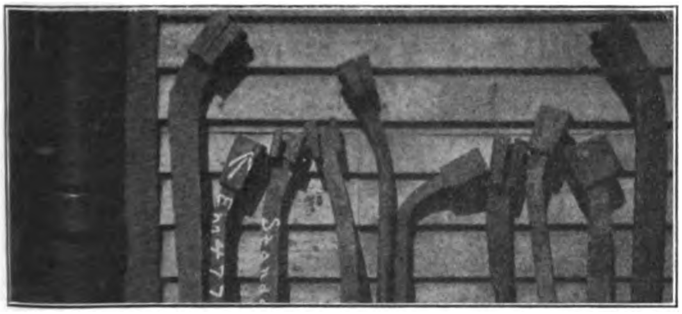
Numerous accidents have occurred due to the failure of autogenously welded seams and cracks in the boiler back head. One fatal accident of this nature occurred where an autogenously welded crack 21½ in. long in the boiler back head failed while the locomotive was hauling a passenger train, resulting in death to the engineer and the serious injury of the fireman. The scalding water and steam escaping through the rupture compelled the engineer to leave the cab



Low Water Caused Autogenous Weld to Open Up for 36 In.

without being able to close the throttle or apply the brakes in the usual way. The engineer and fireman climbed out of and around the left side of the cab to the running board and to the front end of the locomotive, where the angle cock was opened and the brakes applied.

Accidents caused by defective grate-shaking apparatus increased from 48 during the preceding year to 138 during the present year, an increase of 187 per cent. The major portion of these accidents were caused by the shaker bar not having a proper fit on the fulcrum lever. Since it is impossible to avoid the changing of shaker bars from one locomotive to



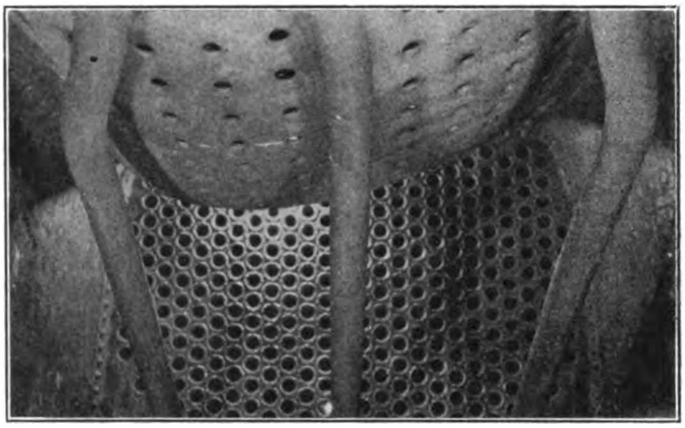
Assortment of Non-Interchangeable Grate Shaker Bars Found at One Small Terminal

another, each carrier should adopt a standard whereby shaker bars are made interchangeable with a proper fit on the fulcrum levers.

Accidents due to the failure of injector steam pipes increased from nine during the preceding year to 40 during the year. A majority of these accidents were due to the injector steam pipe pulling out of the brazing collar due to defective workmanship and to breakage caused by weak, light construction and to defective material. In many instances the failure of injector steam pipes was contributed to by the injector not being properly fastened so as to relieve the steam pipe from the weight and vibration of the injector and its connections.

Accidents which reflect the general condition of driving gear, running gear, etc., increased materially. For instance, main and side rod accidents increased from 23 to 53; valve-gear accidents increased from 18 to 59; and accidents due to failure of reversing gear increased from 53 to 100.

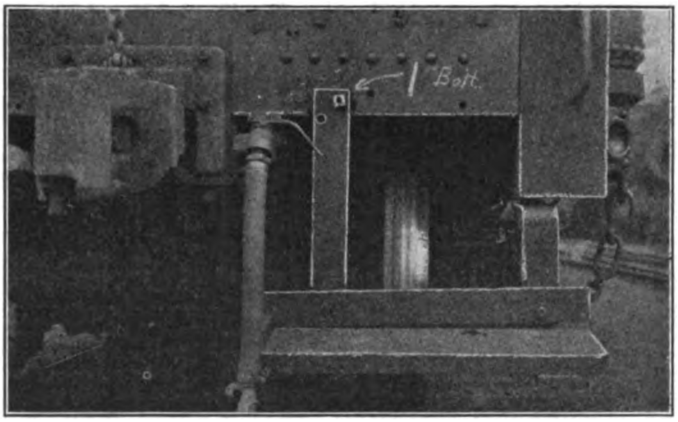
During the year 230 applications were filed for extension



Overheated Crown Sheet Pulled Away from 238 Radial Stays and Pocketed 17½ In. Without Other Material Damage

of time for removal of flues. Investigation disclosed that in 34 cases the condition of the locomotives was such that no extension could be granted. Fourteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period was allowed. Fourteen extensions were granted after defects disclosed had been repaired. Thirty applications were withdrawn and the remaining 138 were granted.

There were filed 5,076 specification cards and 11,187



Dangerous Condition of Footboard Fastenings on Tender of Switch Engine

alteration reports necessary in determining the safe working pressure and other required data for the boilers represented. These cards and reports were analyzed and corrective measures taken with respect to numerous discrepancies which were found. It was required that many older and weak boilers be reinforced or the working pressure reduced.

In two instances appeals were taken from the decision of inspectors and after careful consideration of existing conditions the appeals were partially sustained and partially dismissed. The decisions of these inspectors were technically in error, but practically correct.

The recommendations for betterment of service made at the close of the report were the same as last year. The following is a brief summary of these recommendations:

That the act of February 17, 1911, be amended to provide

PERSONS KILLED AND INJURED, CLASSIFIED ACCORDING TO OCCUPATIONS

	1923		1922		1921		1920	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:								
Engineers	19	484	11	213	15	237	16	272
Firemen	16	597	10	277	25	360	20	404
Brakemen	12	137	7	66	13	64	9	77
Conductors	1	35	..	25	2	20	2	19
Switchmen	2	32	1	13	3	15	4	19
Roundhouse and shop employees:								
Boiler makers	3	19	1	10	1	7	2	9
Machinists	2	14	..	9	1	3	1	20
Foremen	1	6	..	1	1	3	..	3
Inspectors	..	2	..	2	..	5	..	1
Watchmen	1	6	..	3	..	4	4	3
Boiler washers	1	9	..	1	..	7	..	13
Hostlers	..	31	..	10	..	8	..	13
Other round house and shop employers	4	29	1	15	1	25	3	30
Other employees	4	36	2	23	2	16	4	26
Non-employees	6	123	..	41	..	21	1	7
Total	72	1,560	33	709	64	800	66	916

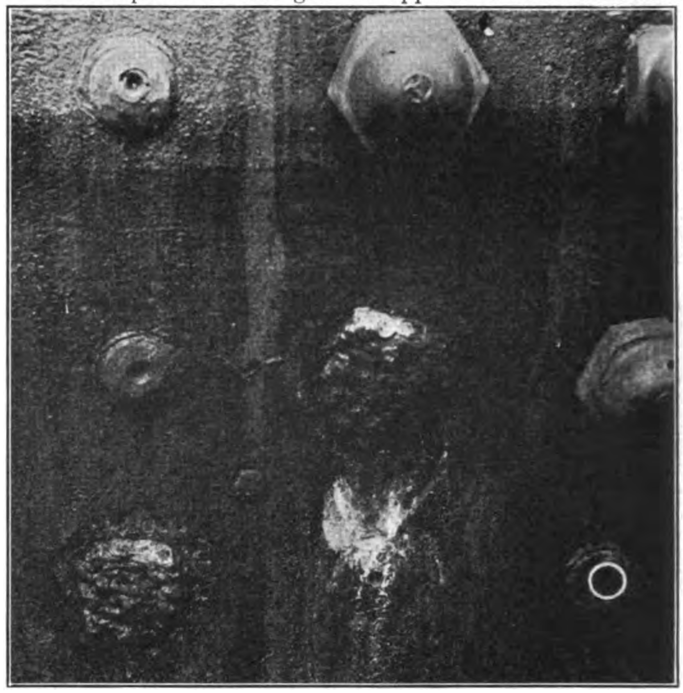
ACCIDENTS AND CASUALTIES RESULTING FROM FAILURES OF LOCOMOTIVES AND TENDERS AND THEIR APPURTENANCES

	Year ended June 30								
	1923			1922			1921		
Part of appurtenance	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	6	..	7	3	..	3	1	..	1
Aprons	8	..	8	11	..	11	16	..	16
Arch tubes	12	2	17	4	..	5	5	..	5
Ash-pan blowers	19	..	19	7	..	7	5	..	5
Axles	6	..	7	5	..	17	5	..	6
Blow-off cocks	28	..	29	16	..	16	14	..	14
Boiler checks	12	..	12	4	..	4	7	1	7
Boiler explosions:									
A. Shell explosions	.....	..	.....	1	..	1	...	..	...
B. Crown sheet; low water; no contributory causes found	19	24	27	13	15	23	20	19	26
C. Crown sheet; low water; contributory causes or defects found	34	15	56	14	6	27	33	24	52
D. Firebox; defective stay bolts, crown stays, or sheets	4	2	5	5	1	5	1	2	...
Brakes and brake rigging	27	1	56	10	2	24	6	..	6
Couplers	25	1	27	21	..	23	11	1	13
Crank pins, collars, etc.	12	..	13	10	..	10	6	3	8
Cross heads and guides	10	..	10	4	..	4	4	1	4
Cylinder cocks and rigging	11	..	11	3	..	3	4	..	4
Cylinder heads and steam chests	8	..	8	3	..	3	6	..	6
Draft appliances	13	..	14	6	..	9	8	..	9
Draw gear	16	2	16	7	..	7	8	1	8
Fire doors, levers, etc.	26	..	26	2	..	2	8	..	8
Flues	44	..	59	28	..	32	32	1	35
Flue pockets	2	..	5	1	1	...	1	1	...
Foot boards	36	1	35	11	1	10	8	3	5
Gage cocks	.....	..	.....	2	..	2	...	..	...
Grease cups	6	1	6	3	..	3	7	..	7
Grate shakers	138	..	138	49	..	49	85	..	85
Handholds	34	2	32	12	1	11	19	..	20
Headlights and brackets	8	..	8	2	..	2	8	2	6
Injectors and connections (not including injector steam pipes)	33	..	33	21	..	24	15	2	13
Injector steam pipes	40	..	46	9	..	9	15	..	17
Lubricators and connections	22	..	22	9	..	9	12	..	12
Lubricator glasses	10	..	10	3	..	3	3	..	3
Patch bolts	3	..	3	...	..	...	...	..	...
Pistons and piston rods	14	1	13	6	..	6	3	..	3
Plugs, arch tube and washout	18	3	27	12	1	19	15	..	18
Plugs in firebox sheets	.....	..	.....	2	..	3	2	..	2
Reversing gear	100	..	100	53	..	53	65	..	65
Rivets	5	..	8	...	..	...	4	..	5
Rods, main and side	53	3	57	23	..	27	18	..	21
Safety valves	.....	..	.....	...	..	...	...	..	...
Sanders	4	..	4	2	..	2	...	..	...
Side bearings	.....	..	.....	1	..	1	...	...	...
Springs and spring rigging	25	2	25	10	1	9	3	..	3
Squirt hose	67	..	69	54	..	54	82	..	82
Stay bolts	7	..	8	6	..	8	...	..	...
Steam piping and blowers	19	..	19	9	..	11	9	..	9
Steam valves	16	1	16	6	..	6	11	..	12
Studs	6	..	8	7	..	8	7	..	7
Superheater tubes	10	..	15	...	..	...	1	..	2
Throttle glands	1	..	1	1	..	1	...	..	...
Throttle leaking	6	..	6	3	1	2	3	..	3
Throttle rigging	19	2	19	5	..	5	1	..	1
Trucks, leading, trailing or tender	25	5	101	11	2	25	6	..	8
Valve gear, eccentrics and rods	59	2	59	18	..	18	10	..	10
Water glasses	35	..	35	19	..	19	25	..	25
Water-glass fittings	7	..	7	6	..	6	2	..	2
Wheels	10	1	19	8	1	7	4	1	4
Miscellaneous	170	1	179	61	..	61	91	2	117
Total	1,348	72	1,560	622	33	709	735	64	800

for not less than 50 additional inspectors and increased compensation adequate to carry out the purpose of the law.

That all coal-burning locomotives have mechanically operated fire doors so constructed that they may be operated by pressure of the foot on a pedal or other suitable device.

That a power reverse gear be applied to all locomotives.

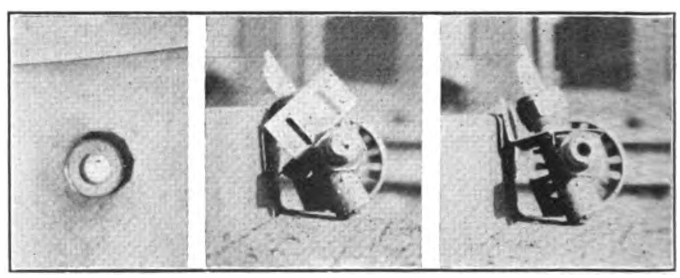


Two Broken Staybolts With Heads Welded Over and One With Hole Plugged *

That all locomotives be provided with an automatic, power-operated bell ringer.

That the cab of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, have a suitable stirrup or other step and a horizontal handle on each side approximately the full length of the cab.

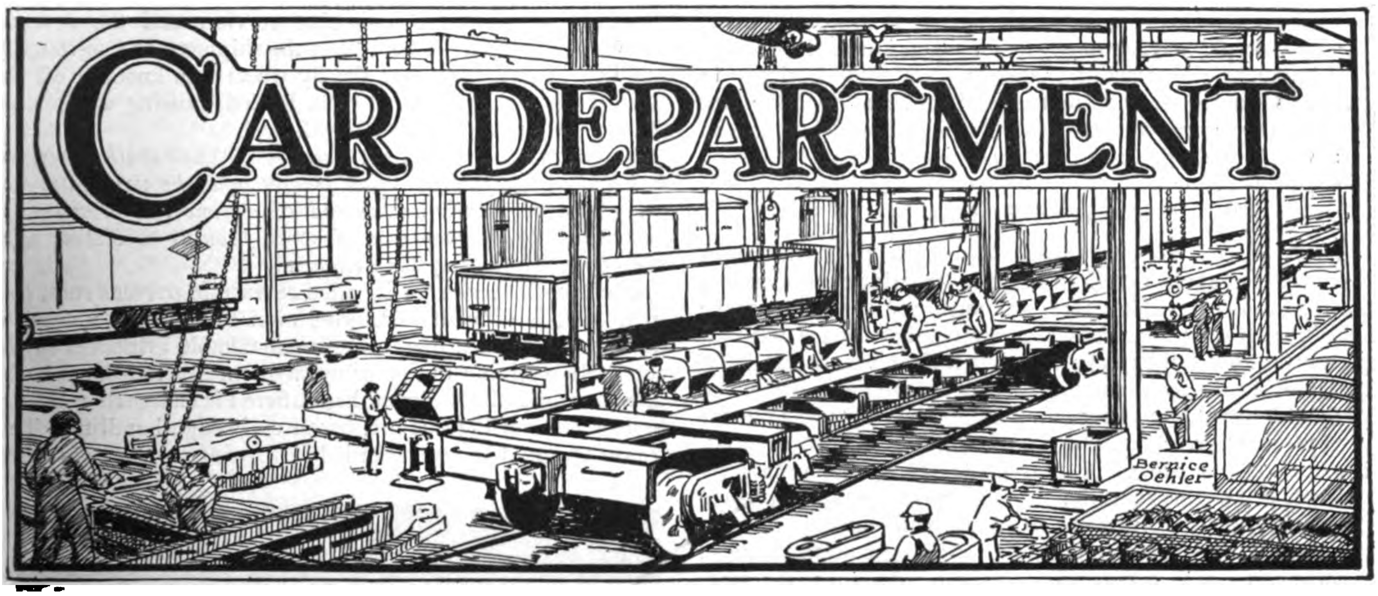
That all locomotives where there is a difference between the readings of the gage cocks and water glass of 2 in. or more under any condition of service, be equipped with a suitable water column, to which shall be attached three gage



Locomotive Was Still in Service, Although Gage Glass Connection Was Practically Closed by Scale

cocks and one water glass, also one water glass with not less than 6 in. clear reading on the left side or back head of the boiler.

HAND BRAKES FOR BRITISH CARS.—By an order made on November 7, 1911, railway companies owning less than 3,000 wagons were given 10 years in which to equip their wagons with brakes on either side; companies having between 3,000 and 20,000 wagons had 15 years, and those with over 20,000 were given 20 years. One result of the recent grouping of the railroads is that while some of the constituent companies had under 20,000, and thus had to complete the work by 1926, under grouping they will get the maximum time.



Car Inspectors' and Car Foremen's Convention

Conclusion of 1923 Convention Report—More of the Papers and Discussion of Billing Rules

A GENERAL report of the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held in Chicago, October 3, 4 and 5, was given in the December issue of the *Railway Mechanical Engineer*. Included in this report was the discussion on Interchange Rules and the paper on Lubrication. Other papers and discussions follow. More will appear next month.

Prevention of Loss and Damage to Freight

By T. A. Ward

District Freight Claim Agent, New York Central

One of the most strikingly successful campaigns of any kind, for increased efficiency, ever carried on by the railroads of this country has been the campaign that they have been waging, and are still waging, to reduce loss and damage to freight and the resulting claims that must be paid.

In spite of this fact the direct losses sustained by the railroads from the inadequate conditioning of goods, as well as from the improper handling of goods while in transit, has in recent years averaged from fifty to one hundred million dollars annually; and to this great loss may properly be added measureless amounts sustained directly or indirectly by producers and consumers through failure adequately to prepare shipments, so that with reasonable handling by the railroads they will reach their destination in sound condition.

Those who discover irregularities, or acts of carelessness in freight handling, and neglect to correct them, or who permit losses or damages to continue without effort to remove the cause, are, unintentionally, perhaps, but surely retarding their own progress, as well as aiding in the continuance of that which others are striving to remove—the avoidable causes for loss and damage to freight.

Daily observation would indicate that at least 40 per cent of the cars actually transferred is on account of improper inspection at the originating point, where cars should have been repaired and placed in fit condition before being loaded, and that at least 60 per cent of the loads adjusted is due to improper cooperage at doorways of cars, cars too weak to withstand the service; a large number of cars having no cooperage whatever to protect the lading, and on open cars improper blocking and staking, coal cars with defective hoppers and doors which have not been properly closed at the mines or in transit.

Loading defective cars before they have been inspected by inspector at the warehouse is a very serious matter. A car might have been all right for the commodity brought in, but not for the outbound shipment. Every car at the warehouse should be inspected after unloading, and markings religiously observed. We are bound to have man failures and some defects cannot be detected by visual inspection. Closed door inspection is made to determine whether there is a ray of light coming through at any point.

Recently I went through some of our yards in a study of hump and flat yard switching, but came out quickly when some cars came together, and I can assure you that it was not at the rate of two or three miles per hour.

Twenty-three million dollars was the cost to the principal railroads of the United States last year in freight claims, because of rough handling of cars, derailments, delay and unlocated damage, and these four causes alone were responsible for almost half of the entire loss and damage bill.

Personally, I do not look upon rough handling of cars as a difficult thing to overcome. We know that most of this is occurring in the yards and there is no good reason to my mind why it cannot be practically, if not entirely, eliminated.

I believe we should make personal appeals to all enginemen and yard men to do what they can to eliminate entirely rough handling and endeavor to build up within them a feeling of interest and a spirit of loyalty, but we must go further and see that instructions given are literally complied with and then give the question of rough handling full and proper supervision at all times.

I cannot think of a more practical plan than to work with the men who actually handle the cars. I am frank in saying that it is my personal opinion that this all-important subject has not yet reached the attention it deserves. I am afraid that a great deal, which has been written and said on this subject, has failed to reach the men who actually perform the work and that sufficient pressure has not yet been brought to

bear, in order to bring about the result that we are after.

It has been said that rough handling, resulting in damage to equipment, is something greater than sixteen times in amount than the damage to freight itself, and that the cost of setting out crippled cars, handling them, and delay to them is a very important factor to be considered in this question of rough handling.

Delay to Freight

Delay of itself not only causes claims, but greatly increases the hazard of theft, deterioration, fire, freezing, and damages by the elements. Therefore, we must see that cars make scheduled trains; that cars requiring weighing are weighed promptly; that hold tracks are switched at least once daily, and that loads requiring repair track movement are given preferred attention. Proper chalking or carding, and the prompt and correct handling of waybills are also essential, if costly delays are to be prevented. Diversion orders require special attention that change may be accomplished promptly and car moved in accordance with the new instructions and to avoid rehandling, delay and resultant damage.

In talking with a general foreman not long ago, he said, "Any number of cases have been brought to my attention where wheels are applied with rusty journals and many more with dents in the journals caused by wheels coming in contact with flanges. These cars run without causing any trouble while they are empty, and many times are overlooked when they come home, but they will show up a hot box when they are loaded and are placed in fast trains."

Again he said, "I was called to make an inspection of a car where the water was dripping through the roof, the roof seeming to be in good condition, there was no apparent reason why this condition should exist. Upon making a closer inspection and having some of the roof boards removed, I found the entire top course of roof boards were applied new, but the old roof paper was left on, which was worn out and the new roof boards were spliced in fifty-six different places. As a result, the entire insulation on this car was water soaked, which necessitated the renewal of the entire roof, ceiling included, not mentioning what happened to the side walls."

The gentlemen who are in the yards most of the time ought to appreciate the difficulties experienced in connection with open-top cars, particularly the hopper type, loaded with bituminous coal. One prominent terminal was handling about five hundred such cars every 24 hours, and those in charge are frequently obliged to arrange for the adjustment of about 50 cars in every 24 hours, due to the bad condition of the hoppers, corrosion and, in some instances, the hoppers not properly pulled up and closed at the point of loading.

A serious condition, as I have noted from time to time, is the lack of energetic methods in handling cars in our terminals for re-icing, when they are condemned for defects. It should be impressed upon the minds of all concerned that perishable freight, particularly under refrigeration, should be treated the same as passenger service. As witnessed in my own visits, some of these cars are sandwiched in with other cars in the train yards at terminals and a serious delay occurs, while to my mind they should not be lost sight of by the yard department or agent, under any circumstances, while being held, particularly in extreme weather. You know how many large claims arise from this source, due to 12 to 36 hours' delay at terminals, which should be overcome through some systematic method.

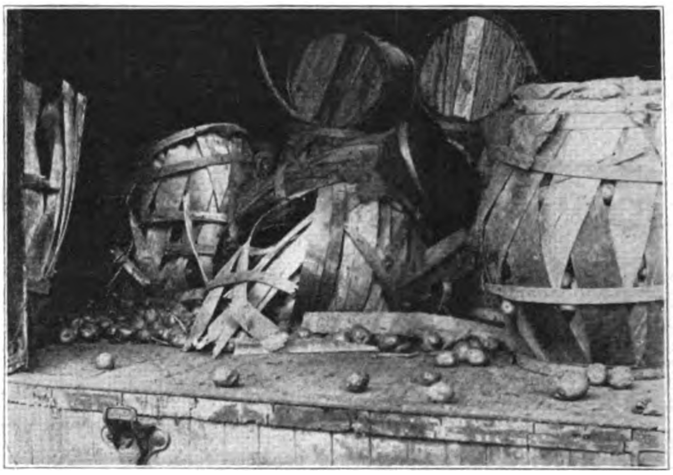
Your help has enabled the carriers to reduce loss and damage considerably during the past year, but there is much more work still to do, and with your assistance we hope to cut down freight loss and damage to the very bone. If we all get into the game wholeheartedly, we can prevent this waste which, directly or indirectly, is a burden upon everyone.

With your permission, I will relate several claims the carriers were obliged to pay during recent months:

Shipments of machinery including an 8-ft. fly wheel, only handled by carrier in switching service, and the revenue derived did not exceed $5.00, yet the shipment was so roughly handled in switching that the fly wheel was knocked off the flat car upon which it had been loaded, causing an expense for repairs amounting to $529.82.

Shipments of machinery, because of their bulk, must be handled as carefully as other freight, and the very nature of the commodity does not extend to anyone the privilege of switching at a higher rate of speed than is consistent with the physical safety of the shipment.

Sheet steel, because of its oiled surface to prevent rust, etc., in transit, is difficult to handle, even in ordinary movement of a car, and when there were unmistakable evidences of the car itself receiving mishandling, it naturally follows that the damage which the shipment has suffered is chargeable directly to negligence of the carriers, because of rough handling. This condition recently was recorded at a point on the rails of an eastern carrier, and, in order to reduce the damage to a minimum, the shipment was returned to the shippers, and the cost of reconditioning totaled $1,969.67.



An Example of Unfit Containers, Poor Loading and No Bracing

A consignment of machinery including grinders, countershafts, etc., properly braced in car to withstand ordinary handling was accepted for movement, and freight charges of $70.09 assessed on the total tonnage of 24,000 lb. When the shipment reached its destination, the machines had been tipped over and badly damaged, the car bearing evidence of mishandling by the carriers. The total cost of repairs was $2,689.89.

Loaded freight cars regardless of their contents should be handled as carefully as a stock of dynamite.

Claim representing damage to shipment of 189 coils of iron wire, moving between two eastern points. This being a carload shipment, it developed that the car was assigned by the receiving clerk to the shippers without proper inspection of the equipment being made to see if it was suitable for this commodity. Car had previously contained salt, was not properly cleaned after unloading, resulting in wire corroding and rendering same unfit for use.

A few minutes of receiving clerk's time spent in proper inspection of the car would have saved carriers $1,269.00.

Discussion

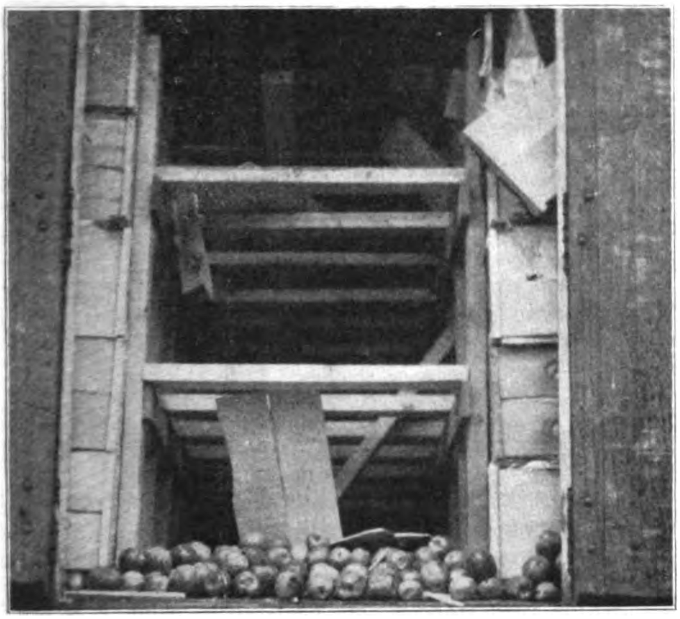
T. J. O'Donnell (Buffalo, N. Y.): When you, as operating men, show a cost per car to your general superintendent, do you realize that cost per car is partially eaten up at the other end of the line by freight claims? When you reduce cost one or two cents a car by five-mile switching, somebody has to pay for it, and the railroad handling that car is the one that pays. I often wonder if our big operating officers realize that, in reducing the cost per car, by taking off car

riders, by hurrying the yard department force, by patting the yardmaster on the back, they are wasting money in some other way.

For the last three years it has been almost impossible to handle cars through our gateway into Canada without transferring at least 20 or 25 cars a day, due to the hoppers being open from three to nine inches, and you cannot do anything with them, due to lack of care at the point of loading. I contend there should be more positive inspection at the gateway of the mines when the equipment is given to the railroad to pull to its destination. That is the place to condemn the car and see if we cannot start it out on its five or six hundred miles in a serviceable condition.

Rough handling of cars and defective equipment mean a transfer of about 800 cars a month out of 350,000 cars, but I am happy to say that our freight equipment, at the present time, is about 30 or 40 per cent better than it was three years ago. We very rarely now run into a 30-ton wooden underframe car.

C. C. Stone (Southern): I would like to ask Mr. Ward if it is not true that initial specification does make the shipper partly responsible for the condition of the car when loaded? The reason I speak of that, a lot of industries order a car for rough freight and take the same car and load it with a finished product. Later, we will get a claim, and the car department has not had an opportunity to inspect the lading.



Good Bracing But Uprights Too Short; Surface Tiers Braced by One Piece of 2-In. by 4-In. Lumber Not Securely Nailed; Load Shifted

Mr. Ward: If the shipper has not given the railroad an opportunity to inspect the lading we would not pay such a claim as that, and I do not believe any other carrier would be forced to pay it. Some carriers might pay a claim like that for policy reasons or something of that kind, but we would not.

W. R. Rogers (Youngstown, Ohio): In selecting cars, we do it in accordance with the supply and demand. If we have a good supply, we give you a good car. If we haven't a good supply, we do the next best thing.

Mr. Ward: That is wrong. You are hurting our claims and you are hurting the operation.

Mr. Rogers: You want the business.

Mr. Ward: No, we don't. We don't want to load a car that is unfit to be loaded. We might get $25 revenue and lose $2,000 in claims. We might better wait to get a car that would carry that load safely to its destination. Any car man who will deliberately say he did not have a car which would carry the load safely, but he took the next best thing, is making a serious mistake.

Mr. Rogers: You misunderstand me. I do not want to take a car for grain without a roof, but the time comes when we haven't a car for 100 per cent loading. Isn't it better to have an inspection at the originating point than to have none, and thereby pro rate the expense of the claim?

Mr. Ward: I would not advocate that at all. That would be contrary to what I am preaching.

E. G. Chenoweth (C. R. I. & P.): I would like to say a word in defense of Mr. Rogers. The claim department, of course, has the idea that we should load cars, in order that there will be no claims or no liability of claims. Now, we know, it is not always possible to furnish A1 cars for the commodity called for, and, therefore, we do the next best thing. While we are more apt to get claims, we are not liable to get claims for every car that we furnish. As the demand gets greater and the car shortage gets greater, we are liable to furnish a less efficient car.

The Rock Island is a grain railroad, and, in following this up all summer, I know we picked A1 cars. We used the flour cars or cement cars for grain, but if we did not have those cars, we surely did not let the loads get away. We used other cars, even if they required double cooperage, and, therefore, while the claim department might say we were disobeying orders, I rather question that statement.

Mr. Zachretz: We card cars for the commodity for which they are supposed to be loaded. We even take cars marked "rough freight" and allow them to go west loaded with rough freight, and when they come back the rough freight tags are still on and they are loaded with grain. Now, how is the car department responsible for that? As mechanical men, all we can do is to see that the cars are properly side carded for the commodity for which they are supposed to be loaded. If they are loaded with some more particular commodity, than I think the freight claim department should get after other departments. They should get after the operating men. They should instruct the agents that when they have a car to be loaded and it is properly marked for rough freight only, they must see that it is not loaded with flour, that it is not loaded with grain. They must see that it is not loaded with anything liable to leakage or damage by moisture.

Mr. Campbell: The proper position of door protection for flour cars is not up to the car department. In the milling district in Minneapolis, where we load about four hundred cars a day, the Western Grain Bureau entered into an agreement with the milling companies whereby it was not necessary to put door protection in the cars. They found they got better results by pyramiding the flour in the car than they did when they had side door protection.

Paper by A. J. Mitchner

[A. J. Mitchner's paper on Car Inspection which won the first prize offered by the *Railway Mechanical Engineer* (see the May, 1923, issue) was read at this point and then discussed as follows:—Editor.]

Jos. Dyer (Youngstown, Ohio): There is one point I would like to have brought out in connection with the report just read, and that is, does a cracked wheel and other live defects show more on a certain type of car?

A. J. Mitchner (M. C.): The defective cracked wheel is caused by the brake striking in the majority of cases. Nine times out of ten it is cracked in the plate, sometimes on the tread. We have also found wheels bursted. That is usually caused by an error in the axle fit.

Chairman Armstrong: I have had much to do in my time with hot boxes, which seem to be receiving considerable attention at this session, and I have seen the time when possibly we might have used very nearly the amount of oil that our friend, Mr. Charlton, said they used, but I am wonder-

ing if he wants us to go home and tell our people that he is using a half pint of free oil to each box.

A. J. Charlton (O. S. N.): I do not mean that we put it in every box; only where it is required. We find some boxes with the packing dry enough to wipe your hands on, and those are the boxes we oil. We find other boxes that have too much.

Paper by Wm. J. Owens

[Wm. J. Owens' paper on Car Inspection which won the *Railway Mechanical Engineer* second prize (see the May, 1923, issue) was read at this point and owing to lack of time there was no discussion.—Editor.]

Questions and Interpretations

Question Box Committee

A. Herbster (N. Y. C.): Before the questions and interpretations are read may I ask if these recommendations will go to the A.R.A. Committee, or will they be followed by the rank and file, in billing?

Chairman Armstrong: Those which Mr. Jamison spoke of as recommendations will now be read and no interpretation issued. We cannot issue an interpretation on a recommendation.

Both questions and answers were read by B. F. Jamison (Southern), chairman of the committee, as follows:

Rule 17—P Triples on Freight Cars

Interpretation 15, following Rule 17, states that triple valves having removable check valve cases are convertible to K type. P-1 and P-2 triple valves have removable check valve cases.

Q.—Should they be considered convertible?

A.—P-1 and P-2 triple valves are not convertible. These valves are for passenger equipment, and Rule 17, Interpretation 15, covers repairs to freight equipment. If a railroad makes use of this type of triple on freight equipment, they will have to be governed by the freight rules. See Supplement No. 1, Item 57-U, 1922 Code.

Mr. O'Donnell (Buffalo): I move that this interpretation be accepted.

The motion was duly seconded and passed.

Car with Worn Flange Derailed and Damaged

Foreign car derailed at *A* end—*B* end not derailed—; cause of derailment "worn flange wheel." When car had been rerailed, it was found to have the following defects, which did not exist previous to the derailment: Brake beam and brake rigging broken at *A* end; truck side bent at *A* end.

Q.—When repairs are made, how should the bill be rendered?

A.—Car owners should be billed with renewal of the wheel, material and labor. The billing repair card for other repairs should be marked "No bill."

The interpretation as rendered was accepted.

M. J. E. Mehan (C. M. & St. P.): I do not think the decision of the committee is correct. As I understand the question, there was a derailment. There was the worn wheel and the damaged truck side, which are at the same end of the car, and if that is true, the damaged truck side has to be taken off, which consumed the labor of the wheel change. Therefore, the labor of the wheel change cannot be charged.

W. W. Wilson (C. & O.): I cannot agree with our friend from Milwaukee, in that the labor would not be applicable in this case because Rule 65 shows where it is a delivering line defect for wheels or axles. There are three arbitration cases, one in particular, if I remember correctly, No. 697. That was rendered in back years, but there are two later cases, No. 1138 and 1156, as well as Rule 42, which at the present time divide the responsibility, whether owner's, or delivering line's, and the committee has always decided that the cause of the derailment is properly charged to the car owner, only if the car has been jacked for the broken frame. I will agree with Mr. Mehan that we cannot charge, because the "Jack Case Decision, No. 1042," states that the delivering line defect shall be the primary cause for removal, and the labor for jacking is not chargeable to the car owner.

Mr. Jamison: Mr. President, the committee agrees that the labor should be charged to the truck side. That is assumed as a responsibility in so far as it is covered in that way and, with the permission of the association we will make that decision so read.

A motion to accept the interpretation was carried.

Rule 33—Safety Appliances

Q.—In view of interpretation under this rule and Arbitration Decision 1277, are the repairs to safety appliances, such as handholds, sillsteps, uncoupling levers and brake shafts, chargeable to the car owner when such are damaged by derailment and not involved with other delivering line damage?

A.—Can be charged when no other delivering line defect exists.

No objection was entered on this decision.

Rule 60—Cleaning Brakes

Rule No. 60, with interpretations, provides that charge cannot be made for the second cleaning of air brakes on the same car, on the same line, within 60 days from the date of the first cleaning.

Q.—Could charge be made for a third cleaning of the air brakes on the same car and road, providing the third cleaning was within 60 days from the second cleaning for which no charge was made, but more than 60 days from the date of the first cleaning?

A.—No charge can be made for such a third or subsequent cleaning. It is simply an evidence that the work has not been correctly performed.

Mr. Jamison: I would like to say that someone spoke a moment ago about the questions not being in proper form. That is the difficulty I have experienced with most all questions I have received, not only for the purpose of this committee handling, but for handling in my own work. As a rule, the person asking a question only gives you meager information, and the committee has borne that in mind, and attempted to give only a general answer, based entirely on the information given. You have no right to assume there is anything else done or not done, when there is any other condition than that which is stated plainly in the question. The following question does not sound very clear, but I understand what is wanted.

Brake Cylinder Gaskets and Bolts

Q.—When a brake cylinder gasket is applied, it is found necessary to renew the brake cylinder bolt, securing the cylinder to the brake cylinder block, account of these bolts being broken on arrival of the car at the shop. Can additional labor be charged?

The questioner means that we get a charge of 93 cents labor for applying a brake cylinder gasket. The detailed statement following that 93 cents, it is anticipated that you would remove the reservoir, which consists of two bolts holding the reservoir to the reservoir block. Now, it is often found that the bolts holding the brake cylinder are broken, and the questioner wants to know if, when these bolts are broken and he has to renew them, he can make an additional charge.

A.—Yes, charge regular bolt labor, as per Rule 107, Items 90 and 91.

The interpretation was accepted.

Charge for Wrong Wheels

A car offered in interchange, stenciled for steel wheels, is found to be equipped with one pair cast iron wheels covered by defect card. The receiving road finds it necessary to renew the cast iron wheels on account of being defective and also finds it necessary to perpetuate wrong repairs by applying cast iron wheels on account of having no steel wheels in stock.

Q.—Is the road that originally carded for the wrong wheels or the road that perpetuated the wrong wheels responsible to the car owner; also what charge, if any, should be made for the application of cast iron wheels at the time wrong repairs were perpetuated?

A.—The intermediate line not applying the steel wheels is in no way responsible for the wrong repairs that were made to the car, as the defect card attached to the car assumes the responsibility of the wrong repairs mentioned, and the charge for cast wheels applied in accordance with Rules 101 and 107 is correct, leaving the defect card on car.

The interpretation was accepted.

Rule 91—Date of Bill for Wrong Repairs

Rule 91 provides that bills rendered one year after date of repairs may be declined.

Q.—Should not the same principle apply in cases of wrong repairs corrected and billing repair card 90 days in possession of car owner and not presented to repairing company for defect card within 90 days after the expiration of a 90 day time limit to match joint evidence card with billing repair card.

A.—Rule 91, second paragraph of Section *A* applies.

The interpretation was accepted.

Change in Type of Triple Valve

Q.—What would be the proper charge for the difference in value of triple valves in the following case:

Non-convertible triple removed.
K-type standard triple applied.
Car stenciled "K type standard" (K-1 or K-2).
Car built January, 1914?

A.—The proper charge in such a case should be $31.40 less a scrap credit of $1 plus the labor charge for cleaning. This is a case of the correction of improper repairs, and comes under Supplement 1, Item 57-P, 1922 code.

Mr. Herbster: Why put the extra charge of cleaning when you consider the triple valve scrapped? The triple valve applied must certainly be cleaned when being applied.

Mr. Jamison: This particular question does not apply to the labor at all. It was merely the question of the difference in the value of the two triple valves. The labor of cleaning is not concerned in the question at all.

Mr. Watkins: Item 57-D says: "Non-convertible on cars built prior to January, 1915, $11.50, with no credit."

Mr. Jamison: The kind of triple valve removed is the non-convertible on a car built prior to January, 1915. That is exactly what this question considered, but if you look at the top of the column, it says, "This triple valve was the kind that was removed when the car was stenciled for same." What kind of a triple valve? A non-convertible valve, or not stenciled at all. But in this case a car was stenciled "K type standard"; therefore, it became a question of correcting wrong repairs and not adding a betterment to the car.

Mr. Watkins: I stand corrected.

Mr. Martin: In answer to Mr. Herbster, as to why it should be necessary to make that labor charge, I believe the rule provides it is necessary to clean the valve as well as the cylinder; if you clean the cylinder, you have to charge for the new valve applied.

Mr. Herbster: That is correct, but the clause should be made that the charge is for cleaning the cylinder and not the triple, so as not to be misleading.

Mr. Jamison: The charge you make for the difference in the triple valve is like the charge you make for an angle cock or a retainer valve; it is not the price of a new article; it is the price of a good article in good condition, and Rule 17 says, in these cases, that the difference in value of the triple valve shall be charged, plus the labor charge of Rule 111, Item 9, $4.22, at the present time. You cannot get away from that.

A motion to accept the interpretation was carried.

Rule 101, Item 140—Coupler Parts

Q.—What is the proper charge for coupler release rod clevis, clevis pin and cotter?

A.—Seventeen cents net, applied to the car, as per Rule 101, Item 140.

Rules 107 and 111—Hand Rail

Q.—How should repairs to hand railings on cars be charged, where such railings are wholly or partly constructed of pipe?

A.—Charge for pipe connections, and the cutting of pipe threads may be charged as per Rule 111. Other operations according to Rule 107.

Chairman Armstrong: If there are no objections, these interpretations will be accepted.

Rule 107—Brake Beam and Bottom Rod

Rule 107, Item 237: Q.—What charge can be made for applying a brake beam tension nut when the beam is not removed?

A.—One-tenth (1/10) hour, as per Item 237, Rule 107, 1922 Code.

The interpretation was accepted.

Rule 107, Item 90: Q.—It is invariably necessary to R. & R. three key bolts when bottom brake rod is R. & R.; is it not proper to charge for the three bolts per Item 90, Rule 107?

A.—The charge shall be confined to key bolts passing through the bottom rod.

Mr. Straub: I move that be rejected.

Chairman Armstrong: State your objections.

Mr. Straub: Because it is necessary to R. & R. three key bolts when you put in a bottom brake rod, nine cases out of ten, so why shouldn't we get paid for it?

Mr. Jamison: I tried to get that two-tenths of an hour for so long I had to give up. If your bottom brake rod is broken and you apply a new brake rod, it is your duty to see that the brakes are properly adjusted; and to adjust your brakes properly, you are going to have to R. & R. your dead lever key bolt, and it is covered by Rule 108.

A motion to accept the interpretation was carried.

Rule 21—Transverse Tie Rod

Rule 21 does not specify the manner in which temporary transverse tie rod shall be applied.

Q.—Should not the repairing road be the judge and charge according to Item 262, Rule 107?
A.—Yes.
Q.—Also should not Rule 21 show "applies only to open top cars?"
A.—No.

It is the understanding of the committee that Rule 31 refers to any kind of a car that needs a temporary transverse tie rod.

Both interpretations were accepted.

Rule 107, Item 254—Release Lever

Q.—What is the proper labor charge for a Carmer (two piece) release lever?

A.—The charge is specifically covered by Item 254, Rule 107, which is eight-tenths of an hour.

The interpretation was accepted.

Rules 101 and 107—Coupler Lock Lift

Q.—What is the proper charge for removing and replacing a coupler lock lift on account of being improperly applied?

I think the questioner was thinking about what we know to be a "stay right," which is secured by a nut, the "stay right" itself being a sort of eye bolt passing through the coupler release lever and secured by a nut. Then the pig tail, as the boys call it, comes down and curls through the lock lift and knuckle lock lift. A great many people put that on backwards, and then the motion of the car going over the road jostles it around so that it must be disconnected and put in right.

A.—On a nut basis.

Rules 101 and 111—Air Brake Work

Rules 101 and 111: Q.—What charge should be allowed for renewing a Wabco packing, this being standard to car, yet it is not a packing leather as mentioned in Item 29, Rule 111.

A.—No charge should be made when the air brakes are not cleaned.

Rule 111. Q.—What is the proper charge for the renewal of a cylinder gasket when the air brakes are not cleaned? The car is so constructed that it is necessary to remove the cylinder from the car to apply the gasket.

Now, this sort of pertains to a question we had a little while ago, and yet it is different. That is the question of the brake cylinder bolt breaking, on account of having to be removed, but in this case your car is so constructed you have to remove the cylinder in place of the reservoir, as is anticipated in Item 11, of Rule 111, it allows us ninety-three cents for renewing a brake cylinder gasket. It is an arbitrary charge specifically covered.

A.—Charge per Rule 111, Item 11.

Conflict, Rules 60 and 90

Rule 60, Interpretation 3, conflicts with Rule 90.

Q.—Which shall govern? A.—There is no confliction, both rules should govern cases referred to.

Chairman Armstrong: Unless there is objection, these interpretations are accepted.

Rule 107—Replacing Arch Bar in Place

Rule 107 (second reading): Q.—What is the proper charge to car owner for repairing a top arch bar in place, when the top arch bar is heated, car jacked and one column nut is applied?

A.—Charge for jacking the car and one nut; that is, labor and material charge for one nut.

[A long discussion of this answer developed the opinion that arch bars should be removed for straightening and the discussion was closed by the Chair as follows:]

Chairman Armstrong: I think it is the intention to hold but one more session and you will realize, then, that I won't have authority much longer, so I am going to take the reins in my hands and say you are either going to take those arch bars off and take them back to the blacksmith shop and have them straightened, or else you are going to confine yourself to the nut charge. (Applause.)

Derailment and Broken Flange

Q.—In case of derailment and you have a broken flange on a wheel with a worn tread or sharp flange, is it proper to charge renewal to car owner?

A.—The initial cause of damage, if an owner's defect, should be billed for, but no subsequent damage should be billed for.

M. J. E. Mehan (C. M. & St. P.): I do not think that answer is correct, as I understand the flange of the wheel was broken in derailment.

Chairman Armstrong: He did not say so, as I understand it.

Mr. Mehan: I think that question presupposes that the broken flange was caused in the derailment. I would so take it from the reading of the question, and, if that is correct, we cannot charge for that wheel at all, even though it was worn out, because the Arbitration Committee has ruled in a case of a worn out wheel. Even though the wheel had given all its life in fair service and had been slid afterwards, the committee ruled that the sliding of the wheels must be the predominant defect, and the fact that the wheel was worn out must be disregarded.

Mr. Sternberg: With the information given the committee I think their answer is correct. The question does not say whether the flange was broken after derailment or before.

Mr. Pyle: I might state that the committee had in mind that it was due to the sharp flange when they rendered their decision.

Rules 87 and 88—Defective Material Renewed on Repairs

Q.—If car owner removes defective material in making repairs, on authority of defect card, shall charge be made for material and labor?

A.—Charge should be made for both material and labor, governed by the provisions of Rules 87 and 88, credit to be allowed for such second-hand material removed as covered by Rule 122.

The interpretation was accepted.

Rule 70—Wheels

Rule 70 (second reading): Q.—ABC railroad delivers a car belonging to an intermediate line railroad to XYZ. On inspection on interchange, a car is found stenciled, "Equipped with Steel Wheels." The car, however, is found to have three pairs steel tired wheels and one pair of cast steel wheels. XYZ railroad demands a defect card from delivering line for one pair cast steel wheels in place of steel tired wheels, under Rule 70.

A.—A defect card is not in order. The car owner has failed to protect the equipment by showing that it is intended that the car should be equipped with steel tired wheels and Rule 70 does not apply.

This interpretation was accepted.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Safety Appliances Damaged in Derailment

On March 27, 1923, Bessemer & Lake Erie Car 41569 was pushed off the end of a switch on the Baltimore & Ohio, which resulted in damage to the truck and safety appliances. The Baltimore & Ohio made complete repairs at its Connellsville shops on April 4, 1922. The cost for the truck repairs was absorbed by the handling line, according to Rule 32, but a bill was rendered against the owner for the cost of repairing the safety appliances, according to Rule 33. The Bessemer objected to the bill for safety appliance defects on the ground that Rule 32 provides that the delivering company is responsible for defects caused by a derailment.

The Baltimore & Ohio took the position that hand-holds, sill steps, grab irons, brake staffs and other similar items are invariably damaged through some form of Rule 32 conditions, and it contended that the above items were properly billable against the owner.

The Arbitration Committee decided that, "Interchange Rule 33 would not apply in this case, therefore the charge for repairs to safety appliances should be cancelled."—*Arbitration Case No.* 1277, *Bessemer & Lake Erie vs. Baltimore & Ohio.*

Damaged Car Moved From Owner to Handling Line and Back

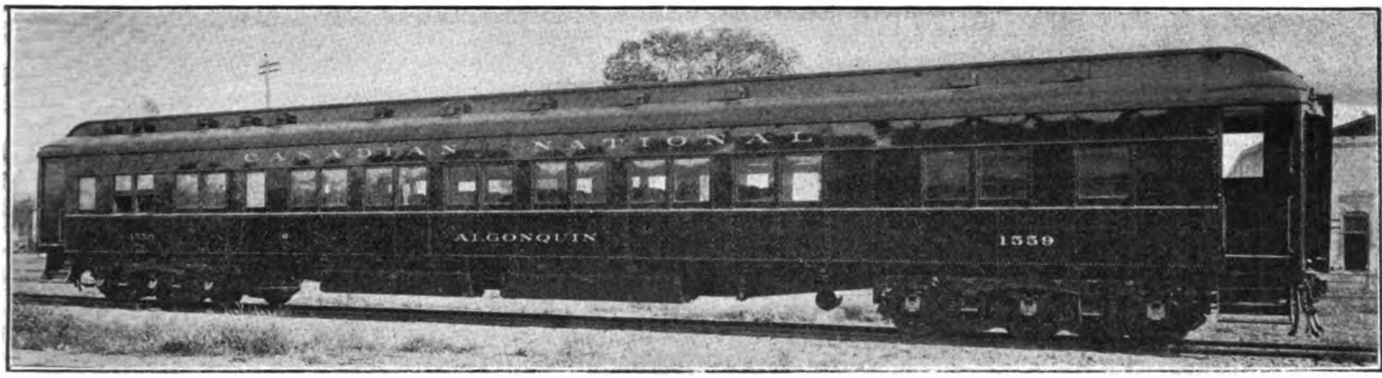
On February 15, 1922, Missouri Pacific car 73362 was received in interchange at Fort Gibson, Okla., by the St. Louis-San Francisco. Neither company maintains mechanical inspectors at this point. The conductor and agent of the St. Louis-San Francisco noticed that the car had slid flat wheels, but in order to avoid delay to a loaded car, they decided to move it to Muskogee, Okla., where it could be unloaded and then sent back to the owner at the point of receipt. This car was again offered in interchange at Fort Gibson on February 25, 1922, with four pairs of slid flat wheels, and the interchange was signed by the Missouri Pacific's agent on the same day. On February 27, the Missouri Pacific sent a car inspector from another point to make inspection of this car on the interchange track. After this inspection was made, he demanded a defect card covering the four pairs of flat wheels from the agent of the St. Louis-San Francisco. The agent refused to issue a defect card, claiming that the wheels were slid flat when the car was received from the Missouri Pacific on February 15.

The Arbitration Committee decided that "the position of the Missouri Pacific is sustained. If the slid wheels existed when the car was offered to the St. Louis-San Francisco, the latter company should have demanded and obtained a defect card from the delivering company."—*Case No.* 1,276, *St. Louis-San Francisco vs. Missouri Pacific.*

Defect Cars Repudiated

TARX tank car No. 2, the property of the Allied Refining Company, arrived at the Okmulgee, Okla., plant of the owner May 23, 1922, with a broken outlet nozzle and a broken oil box, L 4. At that time the car was bearing defect card No. 20, issued by the St. Louis-San Francisco at Okmulgee, Okla., "one broken outlet nozzle." The car, not being in condition for service with the defect as enumerated, it was ordered to the shops of the Peoples Tank Line Company, Coffeyville, Kans. The car was repaired and a bill was rendered against the Allied Refining Company. The St. Louis-San Francisco defect card was removed while the car was in transit from Okmulgee to Coffeyville, and the charges covering the cost of repairs were absorbed by the Allied Refining Company. A bill was presented to the St. Louis-San Francisco by the Allied Refining Company, but the road repudiated it, claiming that there was no record of the car receiving unfair usage and the card had been applied to the car through misinterpretation of the rules by the car inspector at Okmulgee. The Allied Refining Company contended that the handling line had no right to repudiate the defect card and that there was every indication that the car had been involved in a derailment. This claim was further substantiated by a joint inspection made at that time.

The Arbitration Committee rendered the following decision: "The St. Louis-San Francisco should not have removed its defect card, therefore the car owner is entitled to the same in accordance with the rules."—*Case No.* 1,275, *St. Louis-San Francisco vs. Allied Refining Company.*

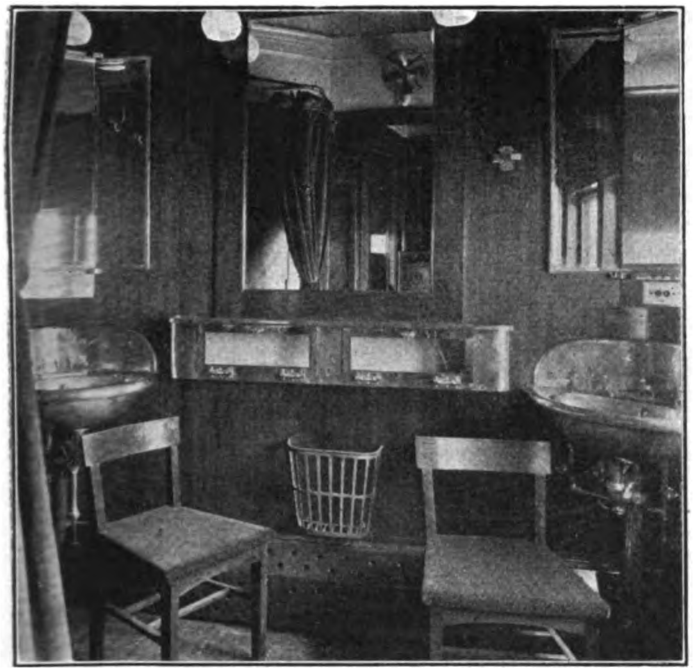


One of 30 New Sleeping Cars Built by the Canadian Car & Foundry Company for the Canadian National

New Canadian National Sleeping Cars

Distinctive Floor Plan Arrangement—Frame and Exterior of Steel; Interior Finished with Wood

DURING the latter part of 1923 the Canadian National received from the Canadian Car & Foundry Company, Montreal, Que., 30 sleeping cars for use in trans-continental trains, in the design of which special attention has been given to the comfort of long distance travelers. The cars are of steel frame construction with fish-belly center sills. They are finished in steel outside, except for a wood and canvas roof, and in wood on the interior.



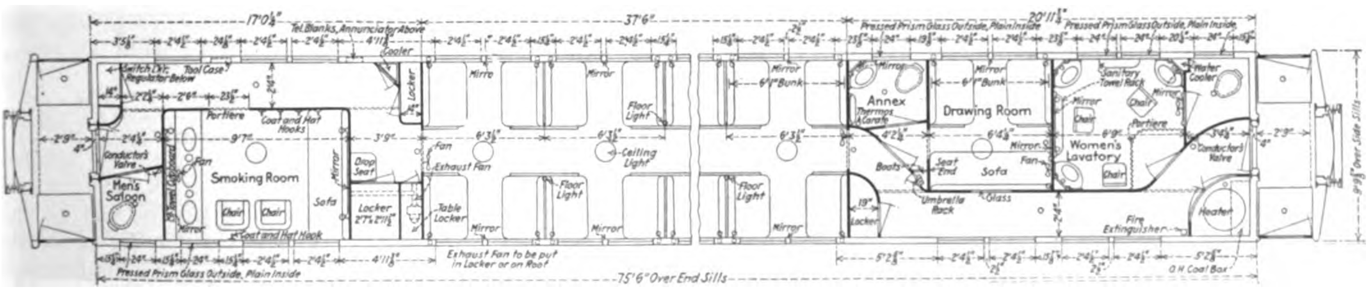
Interior of the Ladies' Dressing Room

The Interior Arrangement

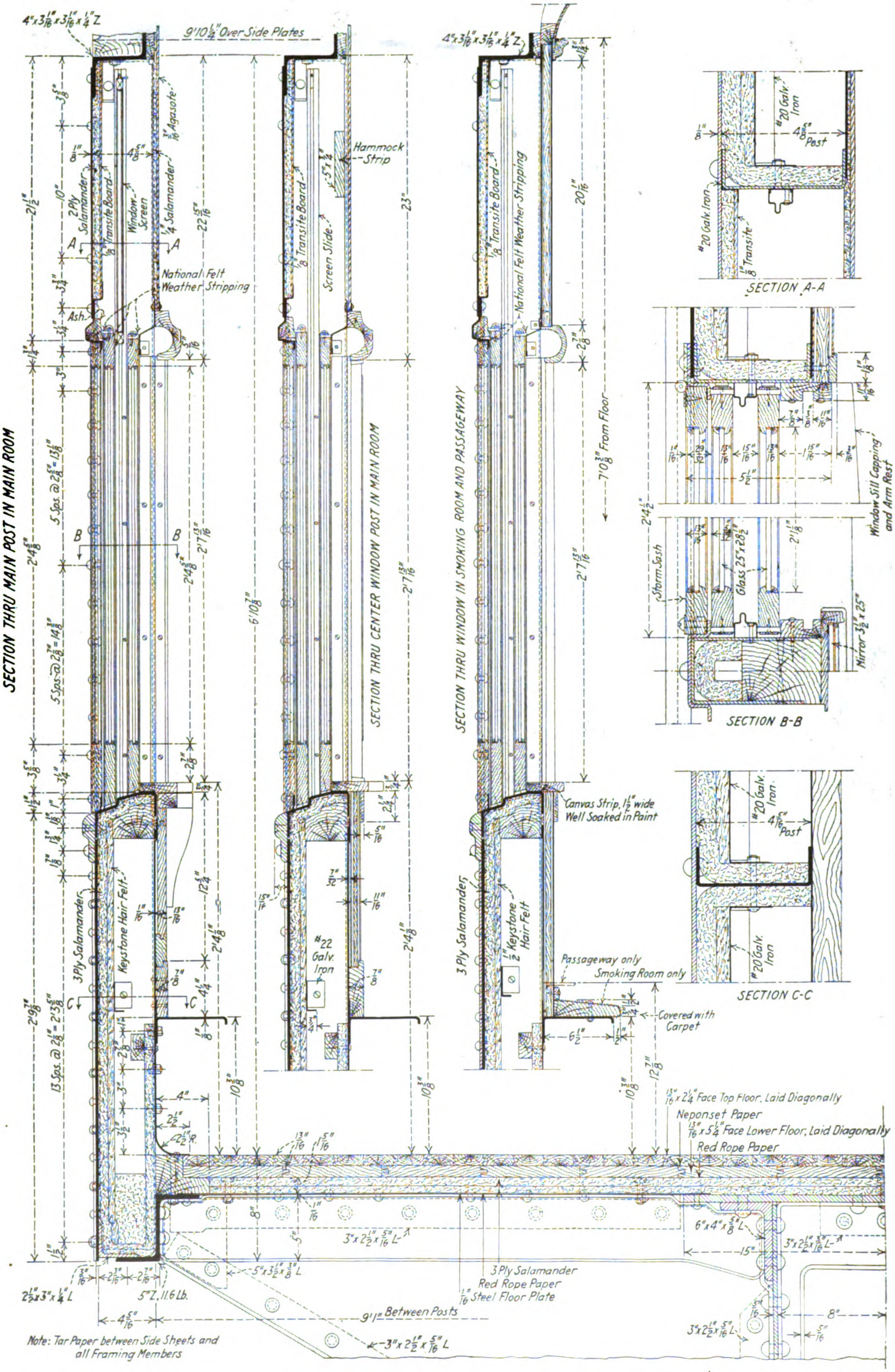
The most interesting features of the new cars are the floor plan arrangement and the special facilities for the comfort and convenience of the traveler. The floor plan is shown in one of the drawings. The cars are 75 ft. 6 in. long over the end sills, about 2 ft. longer than the older equipment, and are provided with twelve sections, which are 6 ft. 2¾ in. long overall and arranged to make up a 6-ft. 1-in. bunk. Except for the location of the ceiling lights, which are placed on the center line of the upper deck ceiling and one in the transverse central plane of each pair of sections instead of in the planes separating the sections, as in the case of Pullman equipment, the arrangement of the sections does not differ materially in appearance from the standard Pullman car. Considerable departure is made, however, in both the men's and women's toilet facilities, and in the case of the women's lavatory, the extra length of the new cars has been used to increase the size of the room to a length of 6 ft. 9 in.

The photograph shows clearly the type of facilities with which the women's dressing room is fitted. These include three wash basins, each in a corner of the room and each of which is fitted with wing mirrors. Towels are kept in sanitary cases, standard on the Canadian National, which are placed at a convenient height so that the top of the case may be used to hold toilet articles. The doors on the front of these cases are hinged at the bottom and are held closed by spring hinges. Each dressing room is provided with three boudoir chairs.

It is the practice on the Canadian National to place the entrance to the men's toilet in the corridor instead of in the end of the smoking room. This makes it possible to place the three wash basins across this end of the room and thus to provide room for two chairs next to the car windows, in addition to the customary sofa across the inner end of the smoking room. The lavatory arrangement in the smoking



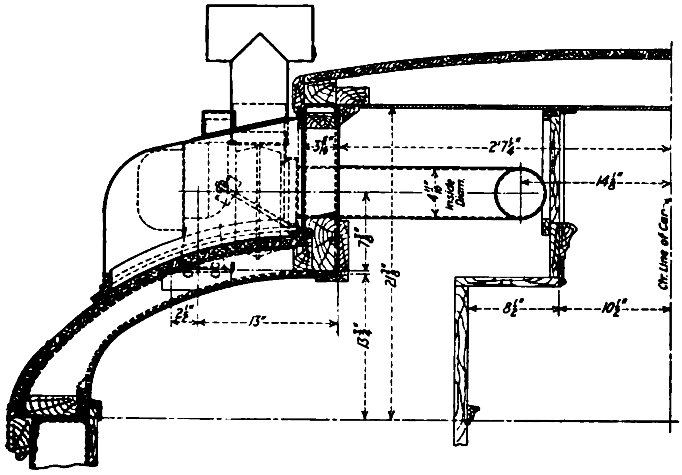
Floor Plan of the Canadian National Sleepers



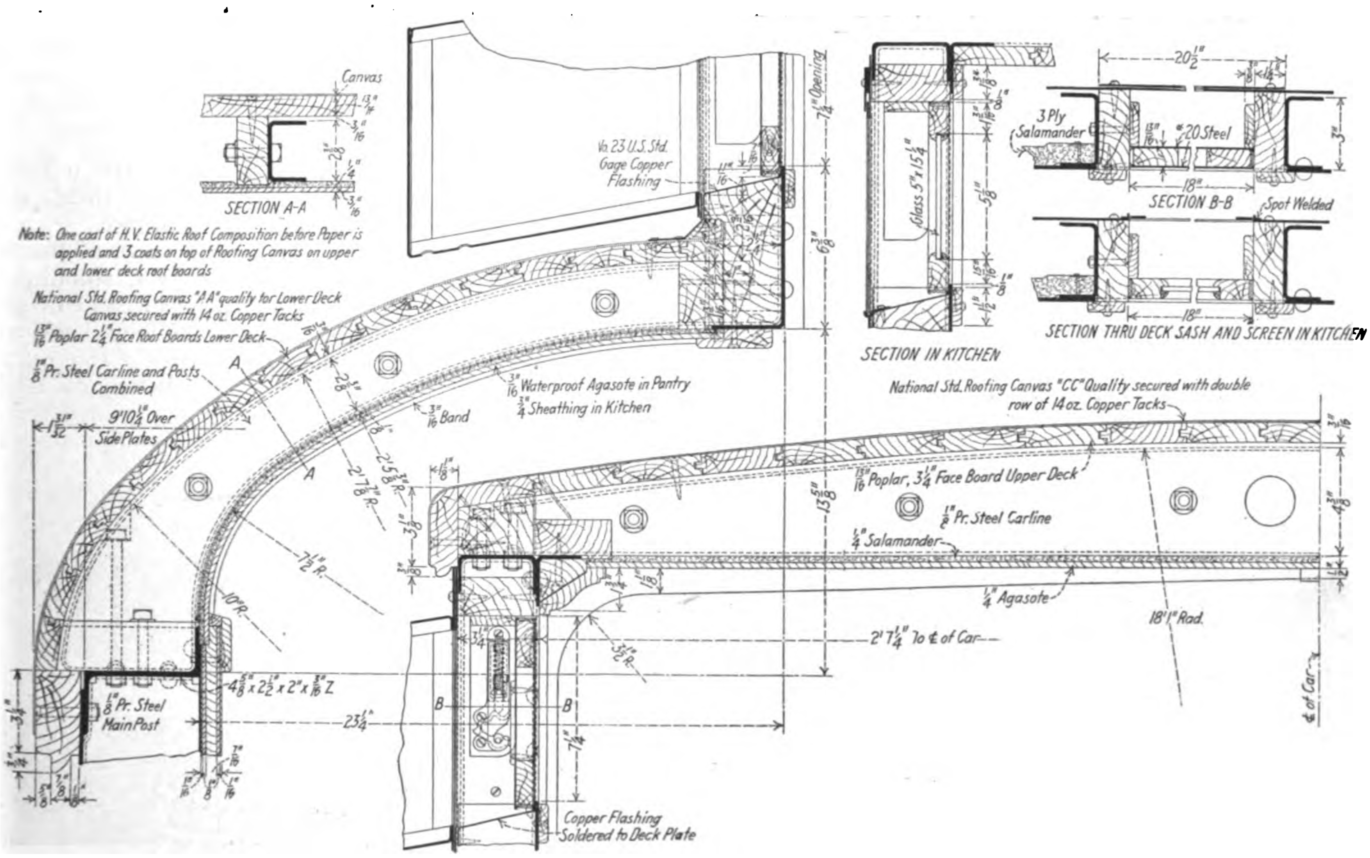
Side Wall and Floor Details, Showing How the Car Is Insulated

room consists of the three wash basins and two dental lavatories, back of which are three sanitary towel cases.

The principal improvement in the sleeping accommodations as compared with older Canadian National sleeping cars is the adoption of separate curtains for the upper and lower berths. The upper berth curtains are arranged so that they may be fastened around a bar on the outer edge of the berth as a provision against the danger of falling out.



Location of the Power Ventilating Fan



Details of Roof Construction Similar to Those Employed on the Sleeping Cars

General Construction

In the drawings are shown a number of the characteristic features of the construction of these cars. The drawing showing the roof details is that of a dining car, but applies also to the sleepers since the same type of construction is standard for all passenger equipment on the Canadian National.

The underframe is built up around fish-belly center sills, which are made of 5/16-in. web plate, with an outside top cord of 6-in. by 4-in. by ⅝-in. angle section with the short flange horizontal, and a top cover plate ½ in. thick by 30 in. wide. The bottom flanges of each sill are made up of inside and outside angles of 3-in. by 3-in. by ⅜-in. section. The deep section of the sills, which measures 2 ft. 6 in. over the flanges of the angles, is 29 ft. ½ in. in length. Through the bolsters each center plate is reinforced by a 14-in. by ⅜-in. plate, 8 ft. 1⅝ in. long riveted on the inside and framed over the vertical flange of the bottom cord angle.

The side sills are built up of 5-in., 11.6-lb. Z-bars, with the top flange turned in, and a 2½-in. by 3-in. by ¼-in. angle riveted to the bottom flange, with the short leg flush with the inside of the steel sheathing.

The bolster is double, of the built-up type, with the two parts spaced 4 ft. 8 in. from center to center. Each part is made up of two ¼-in. pressed steel plates, placed back to back with the flanges attached to the center and side sills, and with flanged steel fillers between the center sills. The bottom cord of each part is completed by a ¼-in. cover plate, 6 in. wide at the ends and tapering to a width of 12 in. under the center sills. The entire bolster is finished with a ¼-in. top cover plate extending from side sill to side sill, and 66 in. wide, longitudinally of the car.

The two crossbearers are 28 ft. apart. Each is made up of a single pressed steel web and center sill filler, flanged at the top and end and with a 5/16-in. top cover plate, 10¼ in. wide, extending across the car from side sill to side sill, and a bottom cord of 3-in. by 2½-in. by 5/16 in. angle section, extending continuously across the car under the center sills.

The floor supports are 3/16-in. channel pressings, 5 in. deep. The entire space between the side and center sills is covered with 1/16-in. floor plate.

The vertical members of the side frame are of ⅛-in. U-section pressings, attached at the bottom to the side sill and at the top to a 4-in. by 3 3/16-in. by 3 1/16-in. by ¼-in Z-bar side plate. The belt rail is a rolled section,

3 11/16 in. deep and 15/16 in. in thickness at the top, the lower portion of which is reduced to 7/16 in. The combined lower deck carlines and clerestory posts are 1/8-in. steel pressings, attached at the top to a 1/8-in. upper deck plate of inverted U-section. To this are attached the 1/8-in. channel section upper deck carlines. Wood carlines are bolted to the steel members as shown in the drawings, which also show in a general way the arrangement of wood members for the attachment of the inside wood finish. Particular attention was given to the insulation. The type and method of application are clearly shown in the drawings.

The cars are carried on Commonwealth six-wheel trucks with cast steel bolsters. The wheels are steel tired, 36 in. in diameter, with 5-in. by 9-in. journals. They are fitted with the American Steel Foundries clasp brake rigging, operated by Westinghouse LN equipment. Locking center pins are used to hold the car body and trucks together, in case of accident.

Heating and Ventilation

The cars are equipped with the Vapor heating system, thermostatic control, and two, three or five-pipe radiators. They are also equipped with a hot water heating system for use in case of emergency or should the cars be required to stand at isolated points where steam is not available. Two types of ventilators are included in this lot of cars. Half of them are of the Mudge-Peerless type and the other half the Utility honeycomb type. In addition to the automatic ventilators, each car is equipped with a 1/16-hp. Sturtevant exhaust fan operating at 1,750 r.p.m. The location of this fan is shown in one of the drawings. It exhausts air from the smoking room and also from the body of the car, at the smoking room end of the aisle, moving a total of approximately 500 cu. ft. of air per min.

The cars are equipped with the Stone-Franklin electric lighting system. The draft gear and buffing mechanism are Miner A-5-P friction type, and Miner B-10 type, respectively. Some of the more important dimensions and data are given in the table:

Weight	169,400 lb.
Length over end sills	75 ft. 6 in.
Length over buffers	84 ft. 4½ in.
Length between truck centers	57 ft. 6 in.
Width over side sills	9 ft. 9⅝ in.
Width overall at eaves	10 ft. 1⅞ in.
Width of clerestory	5 ft. 11¼ in.
Height, rail to center of roof	14 ft. 2 in.
Height, rail to sill at end	3 ft. 7⅝ in.
Height, rail to sill at center	3 ft. 9 in.

Unusual Car Repair Contest on the D. & H.

A $120 Prize Offered for the Best Performance in Rebuilding a Hopper Car; Five Teams Compete

A UNIQUE exhibition of car repairing was given in a contest held by employees of the Car Department of the Delaware & Hudson Company at its Colonie shops on October 31, 1923. The entire woodwork of five D. & H. composite twin hopper cars of 85,000 pounds capacity was removed and rebuilt in record time. These cars are equipped with steel underframes, metal posts and braces; the superstructures are of composite construction—wood and metal—wood predominating. The inner dimensions are: Length 32 ft., width 8 ft. 11 in. In a single car there are 1,947 board feet of lumber.

Five teams of six car repairers each participated in the contest, one team from Carbondale, Pa., representing the Pennsylvania division, one from Oneonta, N. Y., representing the Susquehanna division, and three from Green Island, representing the Saratoga division. At each of these points work of this character is an everyday performance.

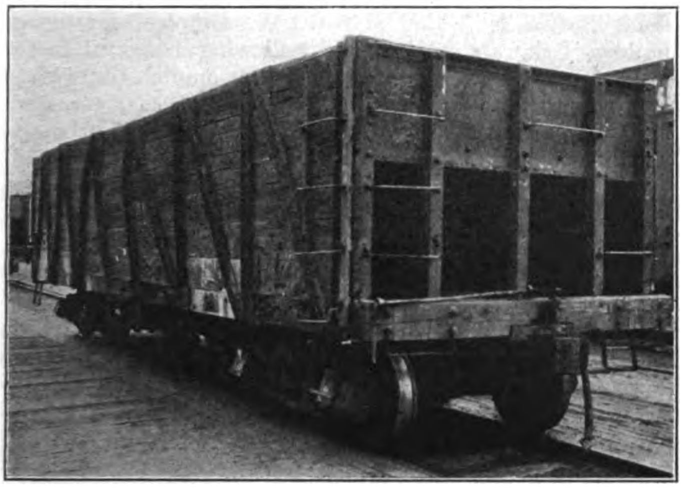
The response which greeted the announcement of the contest assured its successful results. However, stimulus, if any were needed, was provided by a prize of $120 in gold, offered by the management to the team proclaimed the winner upon the basis of workmanship and time. Interest ran high, the foremen were in frequent consultation discussing the probable candidates, and a friendly but spirited rivalry among the men ensued, each division endeavoring to select its best as a representative team.

This project was promoted to exemplify the merits of system and co-operation and the benefits accruing to the

The Winning Team—Left to Right: James Snee, Fred Ross, Larry Zappa, Tony Yaggort (Material Man), John Volano, Louis Moldinaro, C. W. Norris (Divisional Car Foreman), Leo Baker and Raymond Schuster (Foreman)

workmen under the piece-work plan of compensation. The performance indicates that it achieved its purpose.

The plans formulated for the occasion provided for the use of two sets of cars of identical type, the work to be strictly in accordance with standard shop practices. That none of the contestants should be afforded any advantage by reason of home shop conditions prevailing, Colonie, where heavy freight car repairs are made chiefly to box cars, was selected for the demonstration. Each gang worked under the direction of its foreman and the men were detailed to work where, in the opinion of the foreman, they could perform to the best advantage.



The Problem of the Contest—D. & H. Twin Hopper, Composite Car of 85,000 Lb. Capacity

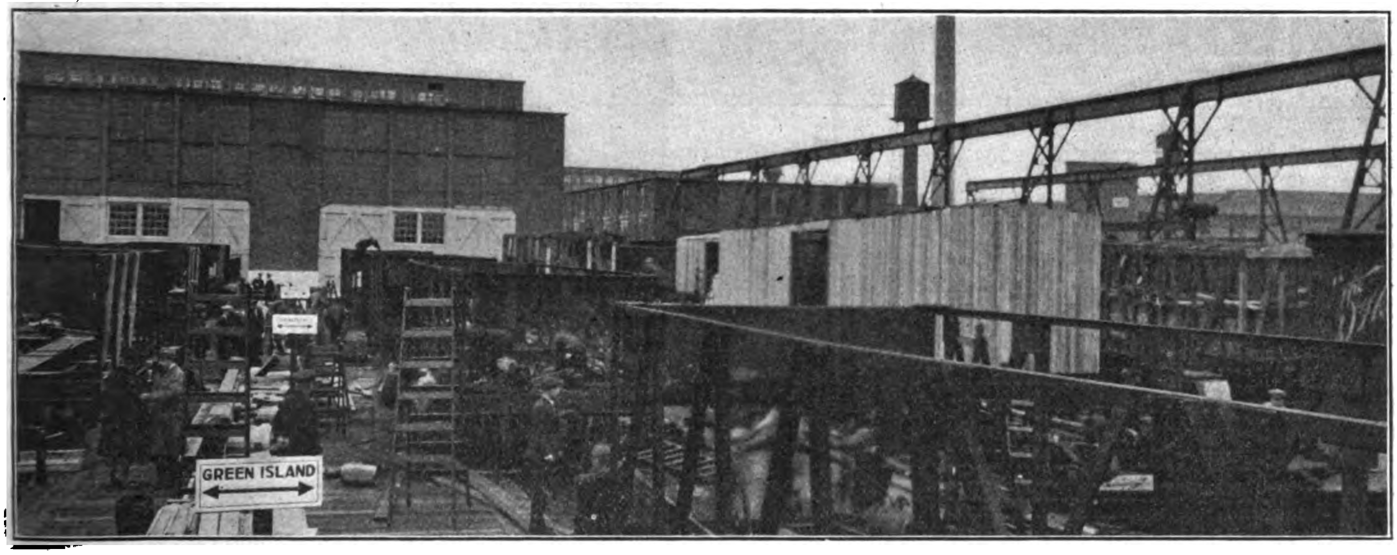
Operations started promptly at 8:00 a. m., proceeding uninterrupted until completion, the men having voted to remain at work throughout the usual lunch period. Coffee and sandwiches were passed around and while this occasioned little delay, no allowance of time was made therefor in the record established.

Five cars in bad order were placed on one track for stripping, proper working space being provided. Likewise arranged on a parallel track were five other cars with the metal work already treated, preparatory to rebuilding, thus avoiding delay. First the tear-down work was undertaken and was completed in remarkably short time, notwithstanding the requirement that each piece of lumber removed should be freed of bolts, nuts and all other metal parts. The Carbondale crew completed the task first, doing so in 1 hour and 37 minutes, and within a very short time thereafter all teams had reported the work of dismantling ended. The maximum time was 1 hour and 57 minutes.

Promptly upon completion of the stripping the men proceeded to the opposite track where the work of construction was begun. Here it was found that all the material required had been systematically arranged, the lumber having been milled out to size and piled in the order of use at each car. Likewise, the necessary forgings and castings had been provided, together with the proper number of bolts.

THE STANDING OF THE FIVE TEAMS

	Time	Applied Man-Hr.
Carbondale Team		
Dismantling	8.00 a. m. to 9.37 a. m.	9 hr. 42 min.
Construction	9.37 a. m. to 3.49 p. m.	37 hr. 12 min.
Complete	8.00 a. m. to 3.49 p. m.	46 hr. 54 min.
Total time, 7 hr. 49 min.		
Green Island Team No. 1		
Dismantling	8.00 a. m. to 9.40 a. m.	10 hr. 0 min.
Construction	9.40 a. m. to 4.05 p. m.	38 hr. 30 min.
Complete	8.00 a. m. to 4.05 p. m.	48 hr. 30 min.
Total time, 8 hr. 5 min.		
Oneonta Team		
Dismantling	8.00 a. m. to 9.43 a. m.	10 hr. 18 min.
Construction	9.43 a. m. to 4.26 p. m.	40 hr. 18 min.
Complete	8.00 a. m. to 4.26 p. m.	50 hr. 36 min.
Total time, 8 hr. 26 min.		
Green Island Team No. 2		
Dismantling	8.00 a. m. to 9.50 a. m.	11 hr. 0 min.
Construction	9.50 a. m. to 5.05 p. m.	43 hr. 30 min.
Complete	8.00 a. m. to 5.05 p. m.	54 hr. 30 min.
Total time, 9 hr. 5 min.		
Green Island Team No. 3		
Dismantling	8.00 a. m. to 9.57 a. m.	11 hr. 42 min.
Construction	9.57 a. m. to 5.36 p. m.	45 hr. 54 min.
Complete	8.00 a. m. to 5.36 p. m.	57 hr. 36 min.
Total time, 9 hr. 36 min.		



This Photograph Was Taken as the Dismantling Was Being Completed—The Carbondale Team Finished Its Car First, in 1 Hour and 37 Minutes

A material man was assigned to each gang, to render the customary assistance.

The material layout was one of the outstanding features, indicating, as it did, efficient and economical shop operation, and affording an ideal opportunity to study that phase of car repairing. The importance of the material feature cannot be overestimated. Its ready accessibility stimulates production and the resultant increased output is reflected in the earnings of the piece-worker.

The repairs made are scheduled as Class 4 with the exception of steel work. In so far as the woodwork is concerned, it constituted a rebuilt superstructure. Two men of each gang were assigned to the task of building and hanging

the hopper doors, after the sides and slopes were up. But in detail each gang attacked its job according to the methods prevailing at the shop represented, and each foreman had an opportunity to compare the effectiveness of his methods with those of the other gangs. One of the interesting features of the contest was the close comparison of the time in which the work was completed by the Carbondale team and the Green Island No. 1 team, although their procedures were different.

In each car 782 holes were bored with the aid of air motors, and in the fitting of wood parts 233 gains were made. A complete bill of material is shown in one of the tables.

The judges were A. A. Burkhard, general car foreman, New York Central Lines, D. H. Pyne, divisional car foreman, Boston & Maine and G. W. Ditmore, master car builder, Delaware & Hudson. Following a careful inspection, this committee reported that in its opinion the work of each team was of equally high standard so that the status of each was fixed by the order of completion, and Carbondale was declared the winner. In awarding the prize, Colonel J. T. Loree, vice-president and general manager of the Delaware & Hudson, an interested spectator throughout the performance, complimented the winners and expressed appreciation of the co-operation evidenced by the results. Thereupon, in behalf of the management, he made a further award of $50 to Green Island Team No. 1, which finished a close second.

As the records indicate, all the contestants made an excellent showing, reflecting credit on the system of training in vogue in the car department. The employees represent practically a new working organization, built up since July, 1922.

Material Used in Each Car

Forgings and Castings

1	Brake wheel
1	Brake shaft
1	Brake pawl
1	Brake pawl ratchet
1	Brake pawl and ratchet bearing
2	Brake step braces
1	Brake shaft support
1	Brake chain
1	Brake cylinder lever fulcrum plate
2	Brake cylinder lever fulcrums
2	Uncoupling levers
2	Sta-Rite uncoupling lever attachments
4	Uncoupling lever brackets and fillers
2	End sill striking angles
4	End sill handholds
2	End sill washer plates
2	Coupler carrier irons
12	Body end stake clips
4	Body side channel stiffeners
4	Body diagonal tie rod level washers
4	Body corner angles
2	Wine side ladders
2	Wine end ladders
8	Body end and side handholds
2	Hopper slope supports, center
2	Hopper slope supports, bottom
2	Hopper slope supports, reinforcing plate
2	Hopper slope supports, casting
4	Hopper slope irons
16	Hopper slope hinges
16	Hopper door hinges
16	Hopper door washer straps
8	Hopper wye irons
4	Hopper door angles
8	Hopper door protection angles

Lumber

12	Side planks, Georgia Pine	716 b. ft.
10	End posts, Oak	106 b. ft.
2	Hopper supports, Oak	28 b. ft.
2	Slope supports, Oak	44 b. ft.
2	Side sill fillers, Georgia Pine	59 b. ft.
4	Center sills, Georgia Pine	19 b. ft.
	Hopper plank, Oak	129 b. ft.
	Slope plank, Oak	576 b. ft.
	Fulcrum block, Oak	4 b. ft.
	Door plank, Oak	111 b. ft.
2	End sills, Oak	135 b. ft.
1	Brake board, Oak	5 b. ft.
	Slope steps, Oak	12 b. ft.
	Fillers, etc., Oak	3 b. ft.

Machine Bolts

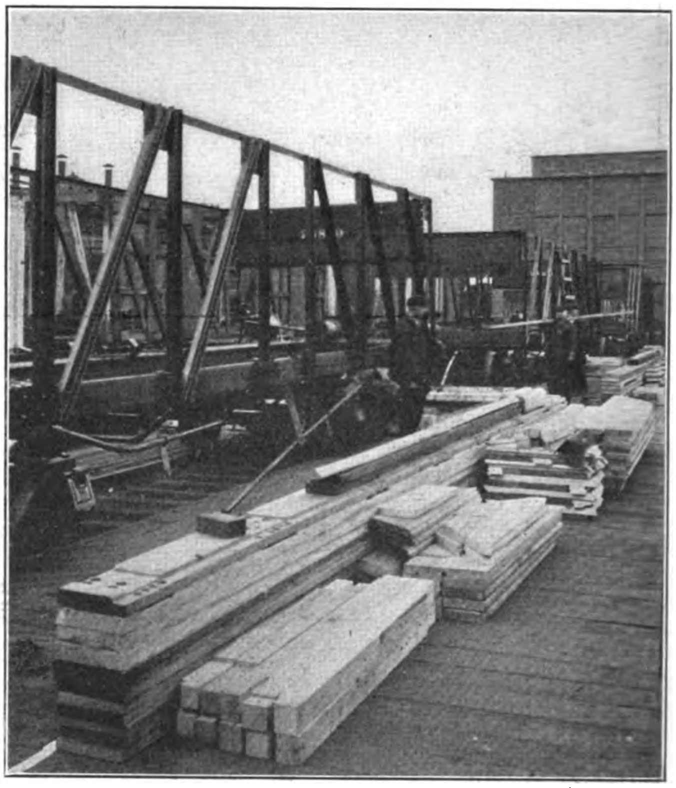
6	½ in. by 2½ in.
68	½ in. by 3 in.
12	½ in. by 4 in.
16	½ in. by 5½ in.
2	½ in. by 10½ in.
6	⅝ in. by 1½ in.
13	⅝ in. by 2 in.
46	⅝ in. by 3 in.
104	⅝ in. by 3½ in.
142	⅝ in. by 4 in.
17	⅝ in. by 4½ in.
24	⅝ in. by 5 in.
4	⅝ in. by 5½ in.
8	⅝ in. by 6 in.
4	⅝ in. by 6½ in.
2	⅝ in. by 7½ in.
26	¾ in. by 5½ in.
20	¾ in. by 6 in.
4	¾ in. by 7 in.
6	¾ in. by 9 in.
4	¾ in. by 10 in.
2	¾ in. by 13 in.
10	¾ in. by 14 in.
8	⅞ in. by 13 in.
4	⅞ in. by 15 in.

Carriage Bolts

198	½ in. by 2½ in.
56	½ in. by 3 in.
36	½ in. by 3½ in.
32	½ in. by 4 in.
32	½ in. by 4½ in.
6	½ in. by 5 in.
50	½ in. by 5½ in.
2	½ in. by 6½ in.

Miscellaneous

4	1¼ in. by 11 in. body diagonal tie
8	⅞ in. by 26 in. door hinge pins
1	1 in. by 9 ft. 5 in. center crosstie rod
2	½ in. by 3 in. lag screws
2	½ in. by 2 in. cotter keys
12	⅜ in. by 3 in. cotter keys
36	⅝ in. grip nuts
8	⅞ in. grip nuts
30	lb. wire nails
21	lb. ½, ⅝, ¾, ⅞ washers
782	holes bored
233	gains made



Steel Work Ready for the Application of the Wood, Which Is Systematically Laid Out for the Teams

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Last Year the 18 larger western railroads were earning a return of only 3.75 per cent on the value of their property held for and used in transportation service. A net operating income of $745,515,000 would be necessary if the railroads of this country earned the 5¼ per cent that is permitted under the Transportation Act. Notwithstanding increased traffic, they will fall short of this income by about $200,000,000. A compilation of the number of employees, hours worked and compensation for the year 1915 and the year 1922 showed an increase of 123 per cent in rate of wages of all employees in 1922 as compared with 1915. The total tax assessed against 23 leading railroads in 1910 was $60,401,109 and in 1922, the tax had increased to $191,822,953, or more than 217 per cent.

Journal Boxes with Anti-Friction Bearings

A Discussion of the Possible Standardization of Ball and Roller Bearings for Railway Cars

By Oscar R. Wikander

IN view of the comparatively limited extent to which vehicles on rails have been equipped with anti-friction bearings, it may appear premature to discuss the question of standardization of journal boxes for such bearings at the present time. The available experience, however, indicates quite clearly certain lines which should be followed in the design of such boxes, in the interest of the railroads as well as of the bearing manufacturers. They may appear obvious, but the fact that they are not generally recognized and followed, makes it appropriate to state them.

OSCAR R. WIKANDER, a Swedish-American engineer, has recently returned from Europe where he made a special study of the application of anti-friction bearings to railway car journals. While abroad, he represented the American Engineering Standards Committee at the First International Ball Bearing Conference held July, 1923, in Zurich, Switzerland. Mr. Wikander is a graduate of the Technical Academy, Chemnitz, Saxony, in Mechanical Engineering, and of the Technical University, Karlsruhe, Germany, in Electrical Engineering. He has had a broad engineering experience in the electrical, mechanical and aeronautical fields, in France, Sweden, Argentine and the United States. During his various activities in this country and abroad, he has been connected with railway work with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and with the General Electric Company of Sweden in Stockholm. He is a member of the American Society of Mechanical Engineers, American Society of Swedish Engineers, Society of Automotive Engineers, Svenska Teknologforeningen, Stockholm, and chairman of the Sub-Committee on Information, of the Sectional Committee on Ball Bearings of the American Engineering Standards Committee.

Advantage of Standard Bearing Sizes

The proposed international standardization of ball bearings, which at the present time is being extended to cover all bearings sizes that might be considered for use in journal boxes, restricts the choice of bearings to a limited number of types and sizes.

To use bearings of special outside dimensions should be discouraged because the grading of standard bearings is fine enough to meet all practical requirements. The use of standard bearing sizes enables the railroad to substitute other makes for the one originally selected, if it should later appear desirable to do so. International standard size bearings are cheaper to buy and can be supplied from stock or on short notice from various manufacturers in different countries.

The proposed international ball bearing sizes are intended to apply to roller bearings as well and will be followed by many leading roller bearing manufacturers. For vehicles on rails it may be taken for granted that only precision roller bearings will be used to any appreciable extent, at least for all applications where the service is comparatively severe and considerable shock loads may occur. On account of their limited shock load capacity, ball bearings have not proved satisfactory for such service.

The Question of the Type of Bearing

A fundamental question in regard to the design of such boxes is whether one or more bearings should be used in each box. In early Swedish designs two self-alining ball bearings were used in each box, one of which carried radial as well as thrust load, while the other carried radial load only. This arrangement was used for freight and passenger cars, while two self-alining radial bearings and one thrust bearing were used for locomotive boxes to take care of the much higher thrust loads that are to be expected.

If journal boxes are equipped with self-alining ball or roller bearings, there is good reason to equip each box with two bearings, because one would not maintain the relative positions of box and axle. It is, however, possible to guide the box from the outside and at least one successful installation is in operation with only one self-alining roller bearing per box. If rigid roller bearings are used, one bearing per box is sufficient. If the wide series are used and this arrangement proves to be successful, it should be adopted wherever possible.

The Single Bearing Box

The following may be considered as the main advantages of the single bearing box as compared with the two or more bearing boxes. First, a solid box covered by one cap may be used. As a rule, two or more bearing boxes are required to be either horizontally split or to have two covers for each box in order to facilitate the mounting and removal of the bearings. Horizontally split boxes were eliminated from modern box construction years ago and railroad engineers are, for very good reasons, strongly opposed to such boxes. Second, one bearing is easier to install, inspect and remove than two or more bearing boxes. Third, the bending moment, caused by the load on the journal box and acting on the axle section at the shoulder of the inside bearing, is smaller in case of the single bearing, on account of the smaller leverage. Consequently it is possible to use a smaller bore for the single bearing than for the inside bearing in a box with two or more bearings. The outside diameter of the single bearing can, in most cases, be made smaller than the outside diameter of the inside bearing in a two-bearing box of the same load carrying capacity. Fourth, the single bearing box is, therefore, smaller, lighter and cheaper than the corresponding box with two or more bearings and is easier to adapt to existing car truck designs.

The load conditions of a railway journal box are such that

they are easily met by one bearing of proper design. They are entirely different from those in the front hub of an automobile, for instance, where the arrangement of two bearings is preferable.

Loading Conditions of a Journal Box

In the case of vehicles running on rails, the wheels are rigidly mounted on the axle, while automobile front wheels turn on a stationary axle. Referring to Fig. 1, a force K_1 acting on the rim of an automobile wheel in the direction of the axle, is effectively taken up by the two forces K_1 and K_2 reacting through the two roller bearings in the hub.

The corresponding thrust force K, which is similar in the case of vehicles on rails, is comparatively small and does not exert any turning moment on the journal box bearing, because the wheels are firmly mounted on the axle as shown in Fig. 2. Such turning moments as may be exerted on the journal box by thrust forces transmitted to the box through the spring or the pedestals, are so small that they can easily be taken up by any roller bearing of the rigid type. The load conditions, therefore, do not justify the arrangement of two or more bearings per box.

Relation of Load and Bearing

The next question to decide is how to place the single bearing in relation to the load acting on the journal box. In order to avoid producing a turning moment which this load would ordinarily do in a longitudinal plane of the bearing, it is of course advisable to place the bearing directly under this force so that the weight of the load passes through the transverse central plane of the bearing.

Selecting the Proper Type of Bearing

Most railroads prescribe a certain maximum bending stress in the axle caused by the static load, and on this basis it is possible to ascertain the maximum load which may be permitted to act in the transverse central plane of any standard roller bearing.

In selecting the proper bearing type, preference will as a rule be given to the wide type of the heavy series, due to the fact that these bearings have the largest load carrying capacity for a given outside diameter or the smallest outside diameter for a given carrying capacity. A small outside diameter is desirable because the space between the center of the axle and the top of the journal box is often limited.

The dimensions of the roller bearings of the wide heavy series are given in Table I. The values given correspond to the latest proposals for international standards for such bearings. Assuming that the maximum permissible bending stress which may occur in the axle end is known, it is then possible to calculate the maximum static load for which each bearing of the above series may be used without exceeding the maximum permissible bending stress. If we let:

Q = the maximum static load on the bearing in pounds, within the limits of the permissible bending stress in the axle.
C = the distance of the bearing center from the axle shoulder against which the bearing is held, or from the section of the axle in which the greatest bending stresses occur.
K_b = the maximum permissible bending stress in lb. per sq. in. prescribed by the railroad for the service in question.
d = the bore of the bearing in inches.

$$A = \text{a constant} = \frac{0.1d^3}{C}$$

Then we can derive the equation

$$Q \times C = 0.1d^3K_b \text{ or } P = AK_b$$

The constant A is different for each bearing bore and depends also upon the distance C. This is composed of half the width of the bearing and sometimes of an additional distance which differs according to the arrangement of the bearing on the shaft.

The following calculations apply to a concrete case: namely, the usual type of a Jaeger roller bearing journal box, as represented in Fig. 3. In this design a disk S is inserted between the roller bearing and the shaft shoulder, which disk occupies a space in the direction of the axle of about 10 mm. It is provided with a large fillet and, therefore, it is very conservative if we assume that

$$C = \tfrac{1}{2} \text{ the width of the bearing} + 10 \text{ mm.}$$

On this basis we have calculated the values of C in Table I. The corresponding maximum values of Q are obtained by multiplying these values by the maximum static bending stress in the axle permitted by the competent authority. The table also contains the catalogue loads of the wide Jaeger roller bearings of the heavy series for 200 and 500 r.p.m.

The following example will illustrate the use of Table I: The new, large freight cars of the German state railways are partly equipped with Jaeger roller bearings of 100 mm. bore, which is equal to 3.9370 in. . The maximum static load per box is 10,000 kg., or 22,000 lb. The maximum permissible bending stress in the axle is 700 kg. per sq. cm., or about 10,000 lb. per sq. in. The maximum speed is 60 km. per hour, or about 37.5 m.p.h. The distance $C = 49 + 10 = 59$ mm., or 2.3229 in., and consequently

$$A = \frac{0.1d^3}{C} = 0.1 \times \frac{3.9370^3}{2.3229} = 2.64$$

We thus find, according to the preceding formula, that

$$Q = AK_b = 2.64 \times 10{,}000 = 26{,}400$$

The bearing load should thus, in view of the maximum permissible bending stress in the axle, not exceed 26,400 lb. As the maximum load only amounts to 10,000 kg., or 22,000 lb., the axle is amply strong. It is thus in every case easy to ascertain whether a bearing from this point of view is suitable for a certain application.

TABLE I

Bearing number	Bored		Outside dia.		Width W		Radius T_1	Distance C		Catalogue load in thousands of lb. at		Constant A	
	Mm.	Inches	Mm.	Inches	Mm.	Inches	Mm.	Mm.	Inches	200 r.p.m.	500 r.p.m.	In sq. cm.	In sq. in.
3,410	50	1.9685	130	5.1181	53	2.0866	1.0	36.5	1.4371	8.4	7.1	3.4	.527
3,411	55	2.1654	140	5.5118	57	2.2441	1.5	38.5	1.5158	9.3	7.9	4.3	.667
3,412	60	2.3622	150	5.9055	60	2.3622	1.5	40	1.5748	10.5	8.9	5.4	.838
3,413	65	2.5591	160	6,2992	64	2.5197	1.5	42	1.6535	11.5	9.8	6.5	1.01
3,414	70	2.7559	180	7.0866	74	2.9134	1.5	47	1.8504	14.7	12.5	7.3	1.14
3,415	75	2.9528	190	7.4803	77	3.0315	1.5	48.5	1.9095	15.8	13.6	8.7	1.35
3,416	80	3.1496	200	7.8740	80	3.1496	2.0	50	1.9685	17.5	14.8	10.3	1.60
3,417	85	3.3465	210	8.2677	86	3.3858	2.0	53	2.0866	18.3	15.6	11.6	1.80
3,418	90	3.5433	225	8.8583	90	3.5433	2.0	55	2.1654	22.3	18.7	13.3	2.064
3,419	95	3.7402	240	9.4488	95	3.7402	2.0	57.5	2.2638	25.8	21.7	14.9	2.314
3,420	100	3.9370	250	9.8425	98	3.8583	2.0	59	2.3229	30.5	25.8	17.0	2.64
3.421	105	4.1339	260	10.2362	100	3.9370	2.0	60	2.3622	35.3	29.9	19.2	2.98
3,422	110	4.3307	280	11.0236	108	4.2520	2.0	64	2.5197	41.0	34.6	20.3	3.15
3,424	120	4.7244	310	12.2047	118	4.6457	2.0	69	2.7166	46.7	38.2	25	3.88
3,426	130	5.1187	340	13.3858	128	5.0394	2.5	74	2.9134	52.9	43.7	29.7	4.61
3,428	140	5.5118	360	14.1732	132	5.1968	2.5	76	2.9922	58.6	49.2	36.2	5.62
3,430	150	5.9055	380	14.9606	138	5.4331	2.5	79	3.1103	64.8	53.4	42.8	6.65
3,432	160	6.2992	400	15.7480	142	5.5905	2.5	81	3.1890	70.3	58.2	50.7	7.87
3,434	170	6.6929	420	16.5354	145	5.7087	3.0	82.5	3.2480	75.6	63.3	59.7	9.27
3.436	180	7.0866	440	17.3228	150	5.9055	3.0	85	3.3465	80.7	68.8	68.7	10.67
3,438	190	7.4803	460	18.1102	155	6.1024	3.0	87.5	3.4449	85.1	....	78.3	12.15

Ratings of Anti-Friction Bearings

The maximum bearing load must furthermore be smaller than the load carrying capacity of the bearing at the maxi-

mum speed at which it has to operate. In order to obtain this load carrying capacity, the catalogue load of the bearing has to be divided by a certain safety factor.

Unfortunately, the catalogue loads of the various anti-friction bearing manufacturers are established on an entirely different basis and can, therefore, not be compared. At times, the ratings of equivalent bearings differ as much as

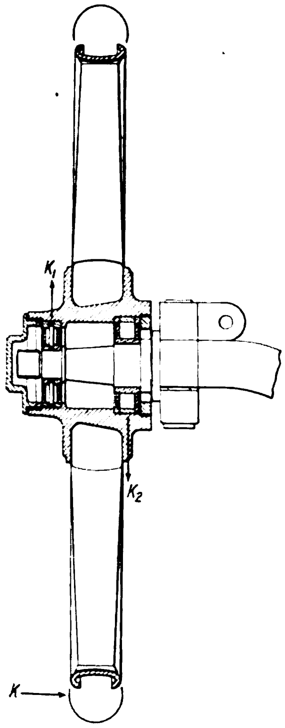


Fig. 1

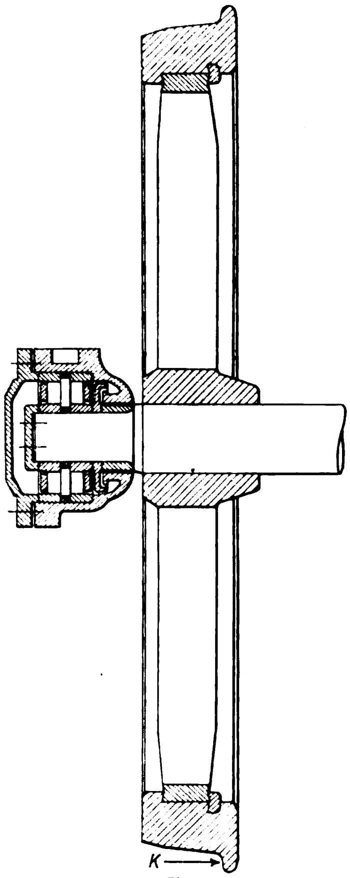


Fig. 2

Contrast Between Automobile and Railway Car Journal Bearing Conditions

100 per cent in the catalogues of different manufacturers.

In case of the Jaeger roller bearings, which have a very conservative rating, it is sufficient to use a factor of safety of 1.3 for journal box bearings, while other bearings, which have about double the catalogue rating, require a factor of safety of 2.6 or more.

In the case under consideration we find that the maximum speed of the axle is 300 r.p.m., for which speed a catalogue load of 13,000 kg. or 28,600 lb., can be computed. For the existing maximum load of 10,000 kg., the corresponding factor of safety is thus 1.3, which is sufficient.

Suggested Basis for Standardization

On the basis of the above considerations, the writer suggests that all designs of railroad journal boxes, to be equipped with anti-friction bearings, be standardized as to the following points: First, bearing sizes should be specified according to the proposed or accepted international standards for ball bearings. Second, each journal box should be a solid steel casting, simply closed by a front cover. Third, the box should contain only one roller bearing and the center line of the load on the journal box should pass through the center of the bearing.

Table I contains in addition to the main dimensions of the standard wide heavy series, also the maximum radii of the shaft shoulder and bearing housing fillets, T_1, which may be used in connection with these bearings.

For the convenience of the users, we give in Table II the

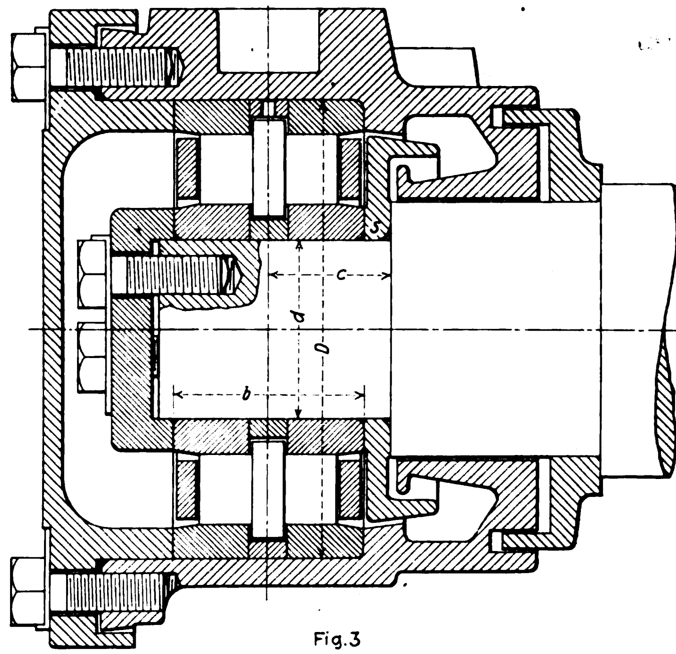


Fig. 3

Sectional View of Car Journal With Single Roller Bearing, Showing Dimensions for Which Standardization Is Proposed

internationally proposed bearing tolerances as well as the axle and housing tolerances, which should be specified.

The German state railways are at the present time preparing or making extensive tests with a number of different anti-friction journal box designs furnished by the various prominent German ball or roller bearing manufacturers, and it is interesting to note that the designs of Jaeger, Krupp, Riebe-Werke, Fichtel & Sachs, follow the above suggested lines of box design, using one centrally located bearing in each box, while two equally prominent manufacturers use two or more bearings per box.

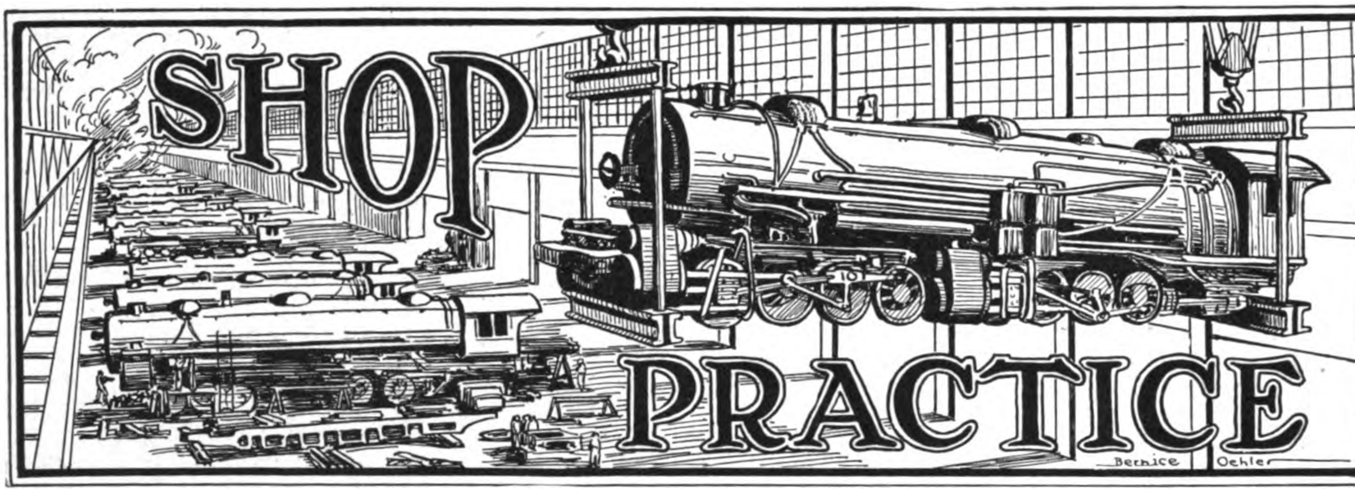
Summary

The author suggests as a basis upon which to standardize journal boxes with anti-friction bearings for vehicles on rails the following for consideration: First, bearings of the proposed international standard sizes should be selected. Second, each journal box should consist of one solid housing closed by a front cover. Third, the box should contain only one bearing and the center line of the load should lay in the transverse central plane of the bearing.

This information will enable the designer to calculate the space needed to apply anti-friction bearings to any truck.

TABLE II

Range of diameters	Corresponding tolerance limits for bearing bore and outside diameter Minimum = O Minimum		Shaft diameter Maximum		Shaft diameter Minimum		Housing bore Maximum		Housing bore Minimum	
	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.
Above 30-50	.012	.0005	.003	.0001	.021	.0008	....	.....	....	.....
Above 50-80	.015	.0006	.005	.0002	.025	.001	....	.....	....	.....
Above 80-120	.020	.0008	.009	.0004	.031	.0012	....	.....	....	.....
Above 120-180	.025	.0010	.012	.0005	.038	.0015	.040	.0016	.013	.0005
Above 180-260	.030	.0012	.015	.0006	.045	.0018	.045	.0018	.015	.0006
Above 260-360	.035	.0014	....	.....	....	.....	.060	.0024	.018	.0007
Above 360-500	.045	.0018	....	.....	....	.....	.070	0028	.020	.0008



Surface Hardening with Oxy-Acetylene Flame

The Torch Process Will Mark Out for Itself a Field Sharply Defined and Superior to Its Competitors

By J. F. Springer

EXPERIMENTS reported in the early part of the present century showed that iron could be impregnated with carbon by heating it in a slow current of carbon monoxide (CO). The temperature was varied from 1,040 deg. to 2,174 deg. F. At the lower temperatures, the period of heat covered eight hours. Some carbon was left as a powdery deposit on the iron surface, and so did not impregnate the metal. From 1,382 deg. up, however, no carbon deposits were formed. It has been assumed that this means that pure iron exposed to CO at such high temperatures must absorb all the carbon actually set free. The investigator checked the amount of carbon absorbed in three different ways. The increase in the weight of the iron constituted one. Second, the residue of the carbon left in the gas was determinable by ascertaining the weight of CO_2 produced from the CO by the abstraction of carbon. Finally, by heating the impregnated metal, in a current of oxygen, the quantity of carbon absorbed could be ascertained.

From the agreement of the three sets of figures, it was possible to get information as to the amount of carbon actually absorbed by the iron at various temperatures. The range from 1,517 deg. to 1,877 deg., proved a most excellent one. It was found to be possible to carbonize iron and presumably soft steel as well, by means of a slowly moving atmosphere of carbon monoxide, provided a moderately high temperature was used.

The flame used in the oxy-acetylene welding and cutting processes supplies a high temperature and also supplies the carbon monoxide. It seems that the correct explanation of what occurs in the flame is that the one volume of acetylene and the one-and-a-fraction volume of oxygen, which emerge together from the heating tip, do not at once undergo a reaction. First, the acetylene decomposes in an explosive manner into carbon and hydrogen. That is, the C_2H_2 breaks up into its constituent gases. All three elements, C, H and O, flow along together for a short space, the carbon producing the whiteness of the little inner flame characteristic of the oxy-acetylene torch. At the outer terminal of this short, white pencil of flame the carbon and oxygen unite and form CO. There is a certain amount of oxygen which varies with different makes of torches, that is supplied in excess of what is actually requisite for the production of CO. This excess, together with oxygen from the surrounding air, is understood to unite with more or less of the CO and with the H to form CO_2 and H_2O. These unions are accomplished in the big enveloping flame which belongs to the oxy-acetylene torch when in action.

From this it has been surmised that the oxy-acetylene torch might perhaps supply CO under conditions of proper temperature to impregnate the surface of an iron or a steel object with carbon. It thus effects a true carbonization of the exterior film of the metal. Naturally, this carbonized film may be heated and quenched with the result that the highly carbonized skin is made very hard, just as is the case when iron and steel objects have been case-hardened in the usual way.

Three Oxy-Acetylene Torch Adjustments

There are in fact three distinct adjustments that may be made on the oxy-acetylene torch. First, there is the normal adjustment when the little white flame is single and sharply defined. With this, the action is more or less neutral, the metal being neither oxidized nor carbonized. Then there is the case where more oxygen is supplied than is required, and this flame acts as an oxidizer. Finally, when less oxygen is supplied than is required for the normal adjustment, we get an excess of acetylene. This means free carbon to a greater or lesser extent. It is the type of flame where an excess of acetylene is supplied that is of particular value in the surface hardening of iron and steel with the oxy-acetylene torch.

A second method of carbonizing is by excluding the oxygen supply that ordinarily goes to the mixing chamber of the torch and there mixes with the acetylene preparatory to the emergence of the mixture from the tip. This amounts to converting the torch into a mere acetylene burner deprived of bunsen-burner openings. A certain amount of success has been attained with this type of flame when used for carbonization purposes. The acetylene flame in contact with the metal surface has produced in two minutes a carbonized film 0.008 in. thick. It is said that the result is similar to that produced by the use of a hardening powder.

If such an acetylene flame is properly applied to the surface of two per cent nickel steel, a two-minute period will be sufficient to effect a penetration of the carbon to a depth of 0.012 in. In the case of a cast-steel object, one may secure with the simple, acetylene flame a carbonized film 0.016 in. thick in the course of 5 minutes. The film will be similar to that produced by a prolonged application of the usual case-hardening process.

Use of the Carbonizing Flame

It is in the adjustment of the torch whereby an excess of acetylene is obtained that we are going to get superior results. A considerable range may be included in this type of adjustment, and this means a range of carbonizing intensity. The normal adjustment of the torch may be made with great precision, simply by using the inner white flame as a guide. When this flame is sharply defined and when it is also single in form, then and then only is the adjustment to be considered normal. From normal adjustment, the deficiency in oxygen may be carried on down until we arrive at the point where no oxygen is supplied to the mixing chamber.

It is to be noted particularly that by a selection of torches and also of the amount of acetylene excess, we may provide for a large range of carbonizing activity. We may vary the velocity of the stream of gas, and we may also vary the excess acetylene in this stream. The work will naturally vary, because it will be desirable to carbonize iron, soft metal and steels of higher contents of carbon. We will also have to handle alloys of various kinds. Carbonization processes are required in great variety because of the services in contemplation and also because of the variations in the metal to be treated.

Limitations of Oxy-Acetylene Carbonizing

There are certain limitations to the process. If a very slow carbonization is necessary in order to produce a given regularity of impregnation, then the oxy-acetylene torch may fail to be a suitable and practical means. It is also probable that the torch method may not be suitable where great regularity, not in degrees of impregnation as the depth increases, but in respect to the area treated, is desired. If the work requires that the impregnation shall be exactly the same all over the surface, then the torch is not to be employed. The torch method should be given careful consideration before it is used, where great exactness is required in any way or form. There are undoubtedly many varieties of case-hardening wanted that the torch can not well supply.

However, there are considerations of convenience, quickness of result, and the like that are on the side of the torch. It is not to be expected that torch-hardening will eventually supplant the older methods altogether, but that it will mark out for itself a field more or less sharply defined and that in this field it will be superior to its competitors.

Main Advantages of the Torch Process

It would appear that the torch method is in competition with those processes which employ powders sprinkled or spread as a paste over the surface. The torch method is to be considered in cases where a very thin carbonized film is satisfactory, and where this film is not required to be uniformly impregnated. Ease and quickness of application are its main advantages. If the requirements as to quality are not too severe, the user of the torch process may find himself greatly benefited.

The carbonizing flame of the oxy-acetylene torch can be made to effect rapid carbonization of the metallic surface. One of the first rules of procedure is to avoid getting the little white pencil-like flame in actual contact with the surface of the metal. If this should happen, we can expect the immediate formation of a superficial alloy of soft iron. In treating Siemens-Martin steel, if the end of the brilliant white pencil of flame is kept 0.6 in. from the metal surface, we may expect to produce a very regular film of carbonized steel containing more than 0.90 per cent of carbon. The major part of the film will consist of tool steel capable of being instantly hardened to a high degree in the usual manner.

By employing the same torch for a period of one minute in treating the surface of a steel casting under the same circumstances, there can be produced a carbonized film 0.012 in. thick. The thin layer is said to be extraordinarily hard and to be similar to that which results when one employs the yellow prussiate of potash.

If the period of application of the oxy-acetylene torch is to be considerably prolonged, it will be necessary to work with a still greater interval between the outer end of the white flame and the surface of the metal. A distance of about 1¼ in. may be necessary. If the proper interval is continually maintained, then we may expect a regular and deep film of high carbon steel.

Apparently there flows from the outer end of the white pencil a stream of uncertain length consisting largely of CO. At some point in this stream, there will be a condition suitable to the metal in hand and the carbonization result desired. The difficulty is to find it. Once found, it is valuable information for future reference.

Experiments on Cast Steel

For purposes of experiment, cast steel was treated for a period of 10 min. with the carbonizing flame, which produced a film 0.12 in. thick. It consisted of steel which nowhere had a higher carbon content than 0.85 per cent. This is just about the dividing point between tool steels and those of a softer character. This metal, when in normal condition, consists of pearlite. The grains of pearlite are not contained in a honeycomb of ferrite nor are they contained in a honeycomb of cementite. Such steel can be hardened by heating and quenching, but it will not harden to the same extent as steel the pearlite grains of which are in a honeycomb of hard cementite.

It is to be remembered that in the natural, unhardened condition, the hardness of steel corresponds pretty well with the content of the hard cementite. Ferrite is soft, as may be seen by testing with a file an ordinary wrought-iron horseshoe nail. Cementite is exceedingly hard, which may be demonstrated by testing a piece of white iron in the same manner. Pearlite consists of alternating layers of these two materials and has an intermediate hardness. Further, the artificial hardness produced by quenching heated steel is roughly in proportion to the natural hardness which it replaces.

Conclusion

With these things in mind, the reader will be fairly well prepared for the following results obtained when the steel surface was exposed to the oxy-acetylene flame at too short a distance from the white pencil. A film having a thickness of 0.08 in. was produced, consisting near the surface of an excessive amount of cementite. Too much hardness was obtained. Even after several attempts at annealing, it was impossible to saw through the materials.

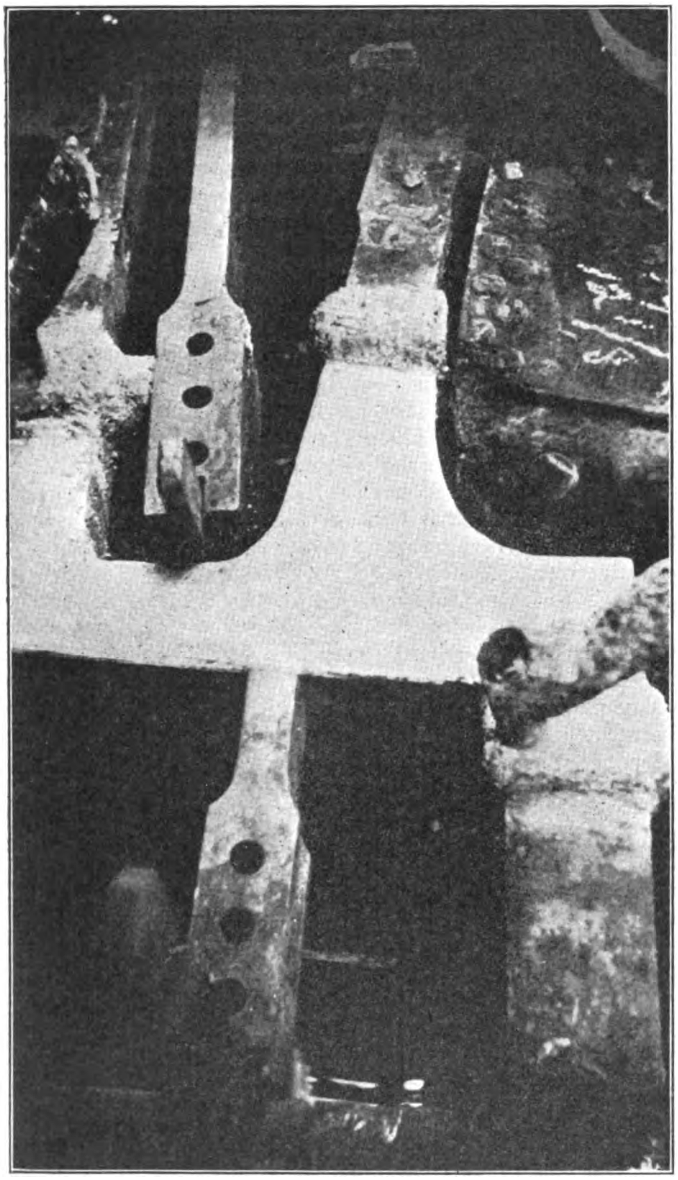
It would seem, that in any particular case, the interval between the outer end of the white pencil and the surface of the work is a matter of prime importance. When the interval is cut down carbon monoxide is supplied in a rather heavy amount. Either the distance should be increased or else the period of operation should be reduced.

An application of the torch for two minutes may suffice to produce a hardness equal to that obtainable with the most energetic of hardening powders. If the period is prolonged to 5 or 10 min., we may secure a carbonization having a depth of 0.08 to 0.12 in. under proper conditions. The carbonization is then very regular and it never attains a carbon content of such a degree that cracking will occur during the quenching.

Spreader for Locomotive Welding

By L. M. O'Kelley
Seaboard Air Line, Tampa, Fla.

THE illustration shows part of a main section that was welded into a locomotive frame on engine No. 647 of the Seaboard Air Line. This is a very common weld for this class of engine, but the method of getting the expansion is somewhat different than that commonly used. As a result of an experience of 15 years in making thermit welds, it is believed that 90 per cent of the defective thermit welds are due to improper expansion. This shop has used jacks, wedges and other devices to get the proper expansion, but nothing, except the spreaders here described, has been found that would not give way to some extent under the high strains. This method was first put in use about two years ago.



Spreader Being Used While Welding Main Section of Frame

The frame, as shown in the illustration, has a goose-neck curve between the main and back pedestals at the point where it passes under the firebox. The weld made just under the corner of the firebox was in repair of a break common to this class of engines.

The spreader consists of an old main rod cut off to fit between the back and main pedestal. On the end of the rod is a 26-in. key made of tire steel, which is driven into the key slot. The rod is placed in the frame as shown and is then wedged in tightly by driving in the key. This device is guaranteed to hold after once set in place with an ordinary 12-lb. sledge hammer. This same type of spreader is also used in getting the expansion in a break between the pedestals. Unlike a jack, it will not give way or yield during the welding operation.

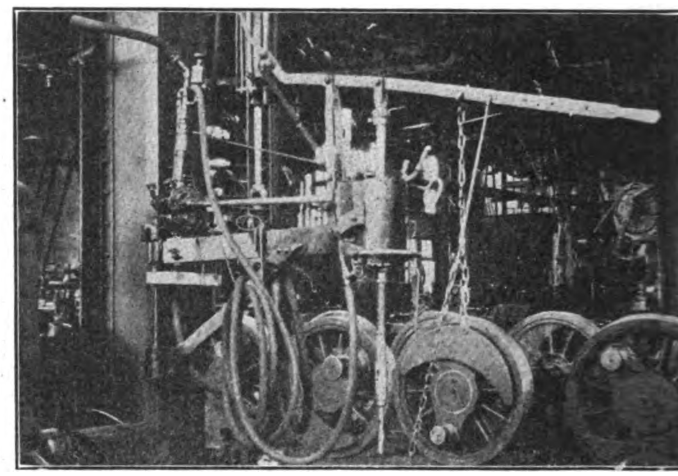
Suggestions for Wheeling Locomotives

By A. S. Duryea
Shop Foreman, Oregon-Washington R.R. & Navigation Co., La Grande, Oregon

TRY to have one locomotive to wheel and one to unwheel, or two to unwheel and one to wheel, as this saves the time it takes to get the equalizer out of the pit and put it back again for each engine.

Always hold the weight of the engine with the crane until the wedges and binders are up and one nut on each end of the binder, then the wheels may be lifted clear of the track and the pins spotted for the rods. This is a quicker and better way of spotting the pins than with the old slipping bar.

When it comes to putting up binders on heavy power, holding the weight of the engine is a big saving as the boxes and saddles will not cock. This makes it possible to straighten them readily which is not easily accomplished with the weight on them.



This Home-Made Drill Press Driven by an Air Motor Saves a Lot of Trucking and Waiting

Formerly we used wooden wedges to hold the boxes straight but sometimes had trouble with them sticking and had to chisel out a few, so we tried the plan as mentioned above. There seems to be no reason why shops of all sizes could not adopt the same method with advantage.

In wheeling a locomotive we use three machinists and their helpers, with two handymen and their helpers and it takes us on an average one hour and forty minutes to have the binders and wedges set up and the engine trammed out. We have done it in an hour and twelve minutes.

We have rigged up a convenient drill press out of an old air motor which fastens onto the rod bushing press, being carried on a swinging arm having a 4 ft. radius. The bushing press holds or clamps the rod while it is being drilled for the oil and the keeper bolt holes. The driving boxes are also drilled on this press and its usefulness is further increased by the addition of a low speed attachment for reaming rod bolt holes. This little machine has accomplished a considerable saving in time as it does away with the trucking of the rods from the drill press to the rod bench and back again.

Suggestions for Improving Shop Management

Methods Are, of Course, Important, But in the Last Analysis It is the Spirit That Counts

First Prize*

By Frank J. Borer
Freight Shop Foreman, Central Railroad of New Jersey, Elizabethport, N. J.

THE problem of the best and most efficient form of shop management has many angles. It is a great deal like advising one as to the best road to heaven. There are many approaches, but there seems to be only one main entrance. To my mind, so far as shop management is concerned, this consists of successful dealing with human nature. This implies consideration, confidence, co-operation, good working conditions and adequate pay according to service rendered, on the one hand, and loyalty and enthusiam on the other.


Frank J. Borer

Successful shop management is not the job of the shop superintendent, works manager, or general foreman alone, but rather the job of every officer and employee concerned with or employed at the shop. Everyone must have a common interest to render service and to contribute his full share to the sum total of the efficiency of the entire plant. To secure this, it is of vital importance that friction and misunderstandings between departments and between the management and the employees be eliminated, or at least reduced to the lowest possible point, and an atmosphere of co-operation, love for service and an incentive to give value for value received be maintained.

The right attitude of the employee towards the job entails a campaign of education and the elimination of harmful outside influences. He must believe in, and have confidence in those in authority. He must be satisfied with his job so far as this is possible in the light of human aspirations.

The Foreman and His Responsibility

The chief burden of the work of educating the employee along these lines falls upon the supervisor, foreman or assistant foreman. He is the "contact man" between the management and the employee. He is the most important link in the chain of successful shop management. To the extent that he is educated in the proper performance of his duties, that he is able to interpret the policy of the company and to use diplomacy in dealing with employees, that he is resourceful, able and impartial, or, on the other hand, that he is hampered by lack of proper education, by petty jealousy, envy, or lacks good judgment or a co-operative spirit towards other departments and his superiors; just to that extent will shop management be successful or not. However, nobody is all good or all bad. Therefore, the thing to strive for is to add to the good qualities and eliminate the bad ones of the members of the supervisory force.

It is quite natural that the morale of the average employee will not and cannot be any higher than that of his immediate superior. He will be inclined to interpret the attitude of the management according to that of his gang foreman or supervisor. It therefore follows that the supervisory force of all departments of the plant should be educated, instructed and guided to see that the state of mind of each one of them is a reflection of that of the higher officers; in this manner the proper spirit will be developed among the employees and the seed of efficiency is bound to grow.

Clear Away Weeds of Misunderstanding

Having cleared away the weeds of misunderstanding, ill-will, jealousy, carelessness, irresponsibility, ignorance and the like, and put in their place good-will, confidence and co-operation, the real work has then just begun, because in problems interwoven with human nature, such as successful shop management, it is like clearing a large field or forest of weeds and underbrush. Both will always grow up again. But the successful forester will hold both of them down to a point where they will not interfere with the growth of the plants or trees.

Foremen's Clubs

In line with this thought, weekly meetings of the supervisory forces are a necessity. They act as a clearing house between sub-department chiefs and gang foremen. They give every supervisor an opportunity to voice his view in regard to any lost motion that may exist in his or other departments and to develop ways and means of overcoming it. Such items as shortage of material supply, new materials received, machinery and tools, shop and safety rules, accidents and how to avoid them, new methods of doing work and shop kinks, reclaiming and storing material, fire hazards and how to thresh out grievances and the best methods of increasing production, should be considered at these meetings. Such

*Mr. Borer's article was awarded the first prize in the Shop Management Competition, which closed September 15, 1923. For other awards see *Railway Mechanical Engineer*, December, 1923, page 794.

conferences put the spotlight on the man who does not come up to the standard and impels him to do better.

This is not enough, however. Lecture courses and occasional meetings with the higher officers should augment them. The Pennsylvania Railroad has gone a long way in this direction, as was so ably explained by I. U. Kershner at the May, 1923, meeting of the New York Railroad Club.* If we want loyal and efficient employees, we must first have a supervisory force imbued with loyalty; therefore the necessity of extending as far as possible the educational features and contact with the management.

As a further means of strengthening co-operation between the management and the employees (which in turn will result in increased and better production) I would suggest that the board of directors, if feasible, set aside new issues of stock to be sold to employees at par on monthly payments, similar to the plan that is now so successfully carried out by the Standard Oil Company. Looking at this plan from the spirit of the saying, "Where thy treasuries are, there is thy heart," much good should come from it. "It is not so much what you produce per hour or per day as it is of how much you can save in producing it" is the way a prominent railroad official recently summed up the problem of increased production.

Causes of Labor Unrest

High wages never did and never will in themselves make men loyal and contented—never will solve the labor problem, although it is understood that reasonable, just wages, according to service, are a means to the end. Labor unrest is not the result of low wages and poor working conditions, or else the American workingman, being the best paid and also the most efficient in the world, would not go on strike. Labor unrest, as it enters into railroad shop management, is for the most part caused by outside agitators. The railroad shop crafts can do much to counteract the bad outside influences and should be afforded every means to work in full accord, through its committees, with the shop management. Employees should have an opportunity to present their grievances to the committeeman and these must be settled impartially.

In applying discipline to employees, care must be exercised to see that they get their just dues on the one hand, and that the efficiency of the forces is not lowered through lack of respect of shop rules or supervisors. In this respect, the system of discipline most in use in railroad shops is too unwieldy. It is either discharge or nothing. Be considerate in the handling and treatment of men. Don't be a quitter. Do not lack in courage but at the same time put yourself in the other fellow's shoes for a moment.

Suggestions for new shop kinks and about improved methods of doing work should be encouraged from employees and supervisors and tried out. If found practical, proper credit should be given these men.

The morale of the force can be raised by affording the men opportunities for self-improvement, recreation, railroad athletic associations and the like; further, by the foremen showing sympathy and interest in the workmen's problems and teaching the less educated the duties of citizenship.

There are always sinister forces at work, especially among the uneducated workingmen, to make them discontented and suspicious, to make them believe they are being robbed, exploited, abused and "bulldozed" by their employers. Little grievances are magnified, are looked at through the microscope. No wonder they look large to them. These bad influences must be counteracted and neutralized. It is not hard, for the truth will prevail in the end. But things do not change of themselves. The shop management must therefore give these things proper attention.

*See Railway Age, May 26, 1923, page 1259.

Reducing the Turnover

The turnover of the employees in normal times is another problem of shop management. To keep good employees in the service and to eliminate those that are falling below a reasonable standard of efficiency is a task of first importance, and there again we have to depend in a large measure upon the gang foremen. A large turnover means a large waste. It can be minimized and production increased at the same time by good working conditions; placing men on work for which they are best suited; by supervisors not showing any partiality; by advising men in regard to shop rules and warning them if minor violations occur; showing appreciation for an extra good job performed in quick time and loyal service in emergencies; rewarding special ability when possible; by not holding out any promises except those that the company is able to keep; not blaming employees for mistakes in workmanship beyond their control or which rightfully belong to the supervisor or some other employee; by enforcing sanitary and safety rules and the prevention of accidents; disciplining the careless man; furnishing supplies and materials as promptly as possible; giving men safe and sufficient tools for the job; explaining the job properly to the man before he proceeds with it; not shifting men from job to job any more than is necessary; specializing in output; and by more careful inspection of work performed.

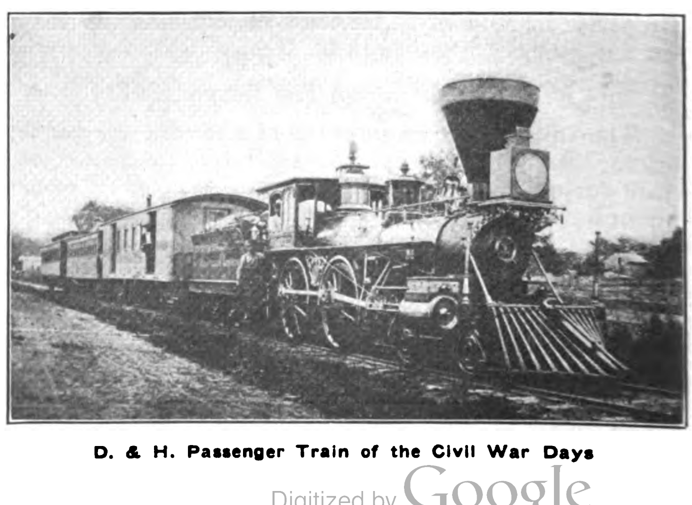
Materials and supplies, and their relation to production to avoid delay to equipment, requires the closest co-operation between the stores departments and the shops. An oversupply is tying up money needed elsewhere and an undersupply is tying up valuable equipment.

A proper, but not too elaborate, cost accounting system is necessary as a measuring stick of the output in relation to man-hours, etc.

Scheduling systems for locomotive and passenger cars are now the rule. However, in freight car repairs the conditions are so varied that different shops use different methods. The station-to-station method of repairing freight cars should be used and extended as much as possible.

The Spirit That Counts

Generally speaking, there must be enthusiasm and a spirit of co-operation to make shop management most successful. It is the spirit that counts and this impels me to tell the following story: "Before the days of the Eighteenth Amendment there was a master down in Dixie-land who gave a special reward to his faithful colored servant upon leaving his service, in the shape of a bottle of brandied peaches. A few weeks later the former servant called at the house and his ex-master asked him how he had liked the bottle of brandied peaches. Said the colored man, 'Well, sah, those peaches, they was all right, but I liked the spirits better in which they were given.' "



D. & H. Passenger Train of the Civil War Days

Classification of Locomotive Repair Shops

Analysis of Shop Operations with the Object of Reducing Expenses and Facilitating Repairs

By George Armstrong

TRANSPORTATION is the primary function of a railroad. In producing this service, the railroads must give more and more attention to proper functioning of motive power and rolling stock.

Increased capacity will be demanded of the railroad machine in the future. Increased capacity with economical service requires the greatest result from the least investment and the minimum expenditure of labor. Cognizance must be taken of the definite relationship between the transportation requirements and the rolling stock and locomotives to handle the traffic. Either new equipment will be needed to provide increased capacity or more effective service must be obtained from existing equipment. The attainment of the most economical service calls for determining the economic balance between the investment in new cars and locomotives, with the attendant burden upon maintenance facilities, and the investment in additional and improved shop equipment and facilities to maintain the locomotives and cars.

Non-Productive Time Spent in Engine Houses

There is considerable room for study of this balance in the increasing of a road's capacity. This is shown by the fact that while the United States Railroad Administration's distribution of locomotive hours showed an average time in road and switching service of 78 per cent of all serviceable locomotives, or an actual effective service of about 40 per cent, individual road returns showed a minimum as low as 14 per cent in road and switching service and a maximum of about 60 per cent. Approximately 50 per cent of the balance of locomotive service time was spent in the enginehouse.

A portion of this non-productive time is undoubtedly due to operating conditions, but a considerable portion is doubtless due to the delay in handling engines through poorly laid out and congested engine terminals, or while making necessary repairs in enginehouses that are inadequately equipped to do the work.

Increasing Actual Working Time

The effect of increasing the proportionate time of road and switching service from 40 to 45 per cent with 500 locomotives would be equivalent to the addition of 45 engines, assuming 80 per cent were in serviceable condition. In other words, without this increase in the effective service of a locomotive, it would be necessary to add 45 locomotives to the 500 already owned in order to deliver the same number of locomotive hours of service daily.

Many roads in the past have increased their capacity by adding new equipment when better equipped roundhouses and shops would have secured the same results, especially in the case of the roundhouse. But money can be borrowed by means of equipment trusts to finance the purchase of new locomotives more readily than it can be secured for improvements to existing facilities. This has been the main reason for increasing hauling capacity in the past rather than by improving terminal facilities. The solution lies in a careful business study leading to a conviction of the economic value of a depreciation fund, not as an account but as a reserve for shop and terminal improvements. A reserve fund should be available that can be drawn upon to replace obsolete or inadequate equipment.

Reduction of Unserviceable Locomotives

Another aspect of the possible increase in the capacity of a railroad due to better terminal facilities should be in the reduction of unserviceable locomotives, such as those held for classified repairs or repairs of over 24 hours' duration. The average number as indicated from the Railroad Administration figures just quoted was 77.6 per cent in serviceable condition, with a minimum of 66.3 per cent and a maximum of 87.5 per cent.

The effect of increasing the percentage of serviceable locomotives from 80 to 85 per cent, in the example of the 500 locomotives, would add 25 serviceable locomotives to those obtained by securing more effective service from the engines already in service. Increasing by five per cent the time of serviceable locomotives in road and switching service and decreasing by the same percentage the unserviceable locomotives, there could be secured the same amount of work from 500 locomotives as could be secured from 570 locomotives without any improvements to the locomotives already owned. Increased capacity by determining the economic balance between an investment in new rolling stock and locomotives, or an investment in additional shop equipment and improvements, demands that terminal facilities should be carefully designed with a view to best meeting future requirements. Labor costs, despite any further deflation from present levels will doubtless be higher than those existing prior to 1914 or 1915. Honest, efficient and economical service demands the largest possible return from every dollar of wages paid.

Three Divisions of Shop Classification

The system of shop facilities to best meet the new situation comprises three divisions. First, a roundhouse with an auxiliary machine shop having a pit capacity for two or more locomotives. This roundhouse to be located at each large division point or at every other division point. The auxiliary shop to be devoted exclusively to the making of heavy running repairs. Second, an intensive locomotive repair shop for repairing locomotives only. This shop should make no heavy running repairs or do any manufacturing work. It should be designed with a view to making quick repairs to a small number of engines in the shop at one time. Third, a centralized production or manufacturing shop. There should be a separate organization capable of finishing all repair parts not standard commercial articles, which can be completely finished or semi-finished ready for use in the repairing of locomotives.

Proper Use of Roundhouses

A roundhouse is primarily designed for the housing of locomotives and is not well adapted to the making of extensive repairs. On the other hand, a repair shop cannot properly function if the making of classified repairs is to be continually interrupted in order to take care of heavy running repairs. Consequently, the making of heavy running repairs and monthly boiler washing and repairs should be performed in an auxiliary shop operated in conjunction with the roundhouse. This should eliminate a great amount of unnecessary running back and forth from the machine to the work when the repairs are being made at some point in the roundhouse. This arrangement will permit the proper supervision of heavy running repair forces and will reduce the unsupervised force

to a minimum on account of the fact that only minor repairs and adjustments would be made in the roundhouse proper. Such an auxiliary shop should be considered at each important division terminal, also on a great many roads where intermediate terminals are simply turn-around points.

An auxiliary shop at every second divisional terminal should be adequate to meet all requirements of the roundhouse. The exact division allocation of these auxiliary shops can only be determined after a careful study of the operating conditions. Sufficient auxiliary shops should be provided to adequately maintain power between shoppings for classified repairs.

A great deal of needless expenditure for maintenance of equipment in roundhouses is incurred through the practice of patching just enough to allow the engine to make another round trip or two. This is not only a waste of money, but frequently results in the necessity for a great deal more work to be done when real repairs are made. It is also an important factor towards decreasing the mileage as well as increasing the length of time required to be spent in the shop for classified repairs.

If the locomotive requires work to be done on any portion of the rods, wheels or cylinders, which, outside of the boiler work, constitutes the major portion of roundhouse repairs, careful attention should be given to such repairs in order that when the engine is returned to service it will not return again within a short time. Careless work usually requires early removal from service in order that attention can be given to some other portion of the same machinery. If the lateral is required to be taken up on one pair of driving wheels, the others should receive attention at the same time in order that, when a month or six weeks roll around, it will not be necessary to remove the same locomotive from service to take care of the remaining wheels.

The Auxiliary Repair Shop

Some objections will no doubt be presented to the practice of operating an auxiliary shop because there is a duplication of equipment. Inasmuch as the average investment for shops and enginehouses, which includes car repair shops, amounts to approximately 50 per cent of the investment in locomotives. It is believed that a careful, analytic study will justify the triple grouping of mechanical facilities as previously outlined. The equipment of an auxiliary repair shop should include some means for removing wheels of locomotives either by a drop pit or with a Whiting locomotive hoist. A ten or fifteen ton traveling crane over the erecting shop portion and the wheel turning and tire boring machine should also be installed. Other machine tool equipment should include a crank shaper or crank planer, a 36-in. vertical or radial drill press or heavy duty drilling machine, a 36-in. engine lathe, two 16-in. by 8-ft. or 20-in. by 8-ft. engine lathes, an electric welder, 36-in, punch and shear, 150-lb. hammer, flue cutter and such minor equipment as may be necessary.

Aside from the physical aspect of the engine terminal in relation to the efficient repair of locomotives, attention should also be given to such details of terminal layout as will expedite outside operations and afford the maximum time available for making adjustments and minor repairs.

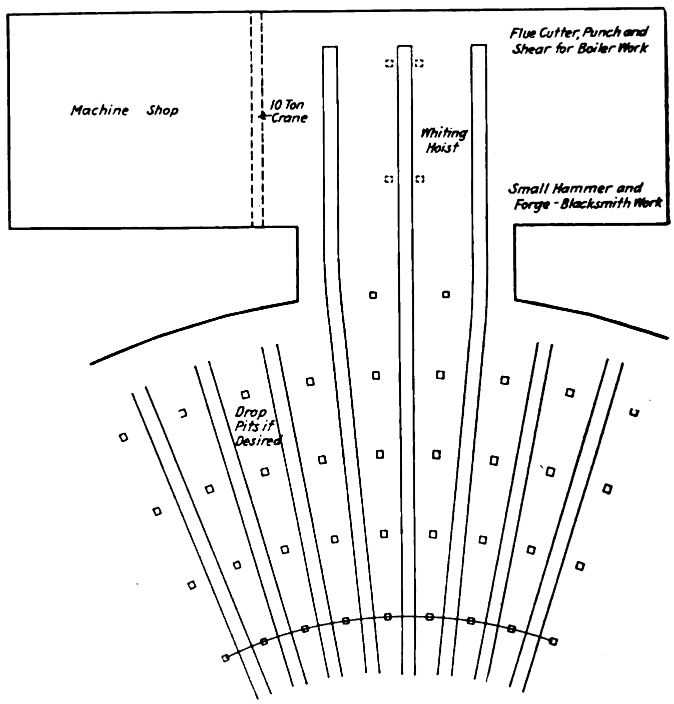
Outlying Inspection Shed and Pit

Foremost among these provisions is that of an outlying inspection shed and pit at all terminals handling 24 or more engines daily. Through such a system advance notice of heavy repair requirements can be obtained. Preparation for the necessary work can be made and it can be determined whether the engine will be diverted to the auxiliary shop or repaired outside. At the same time the inspector or his helper can attend to many minor defects as they are revealed, thus eliminating any possibility of their being overlooked. This will also do away with the unnecessary expense incident to making out a report for some one to apply a cotter, tighten nuts or replace a missing nut.

Provision for Straight Line Movements

Another important feature of terminal design is the provision for straight line movements from the time the engine is received on the incoming track until it hits the turntable. Back steps result in delays. Ample crossovers should be provided so that the engines can be run around when necessary. In fact, the keynote of the terminal design should be "Every movement counts and delays are costly." Expedited terminal operation is only one of the problems of getting the most out of equipment. Classified repairs to equipment present a problem with a somewhat different aspect.

In securing the maximum service from every locomotive it is essential that each one be held from service for classified repairs as short a time as possible. This result can best be secured by holding from service as small a number of locomotives as can be quickly repaired. A carefully planned shop with a balanced quota of machine tools suitable for doing the work can, under good management, literally "push an engine through."



Arrangement of Auxiliary Shop Operated in Conjunction With Roundhouse

Employment of Scheduling System

In securing this result more is demanded, however, than a shop. Advance information must be furnished at least two months previous to the time the engine is to be shopped as to what major parts, such as cylinders, wheel centers, deck castings, flue sheets, etc., will require replacement. These should be ordered long enough in advance that they may be available at the time the engine comes into the shop for repairs. A scheduling system must be employed that schedules, not one that merely indicates what is to be desired. Railroad trains are not scheduled over a division according to the desire of the various individuals operating the trains. They are scheduled in accordane with a careully worked out time card and although this is not always lived up to, any deviations therefrom are charged up as delays. The same should be true of a shop scheduling system. Careful analysis, preferably on a man-hour or shop-hour basis, should be made and once having established a

schedule, every effort should be made to adhere to it. If subsequent results indicate that a change in the schedule is required, then that change should be made in the master schedule.

A cost accounting system should be installed. It is absolutely impossible to secure any comprehensive information as to the cost of repairing locomotives, if the foreman or workman is depended upon to allocate the expense. The average workman is not a good timekeeper or bookkeeper and it is an injustice to the foreman to expect him to properly supervise and at the same time do such work. A simple, comprehensive cost system would be one allocating repair costs to the major units of a locomotive; for instance, to rods, firebox, cylinders, wheels, cab work, etc. Overhead distribution should be made by departments and some system of time keeping with time keepers located in each department, should be employed.

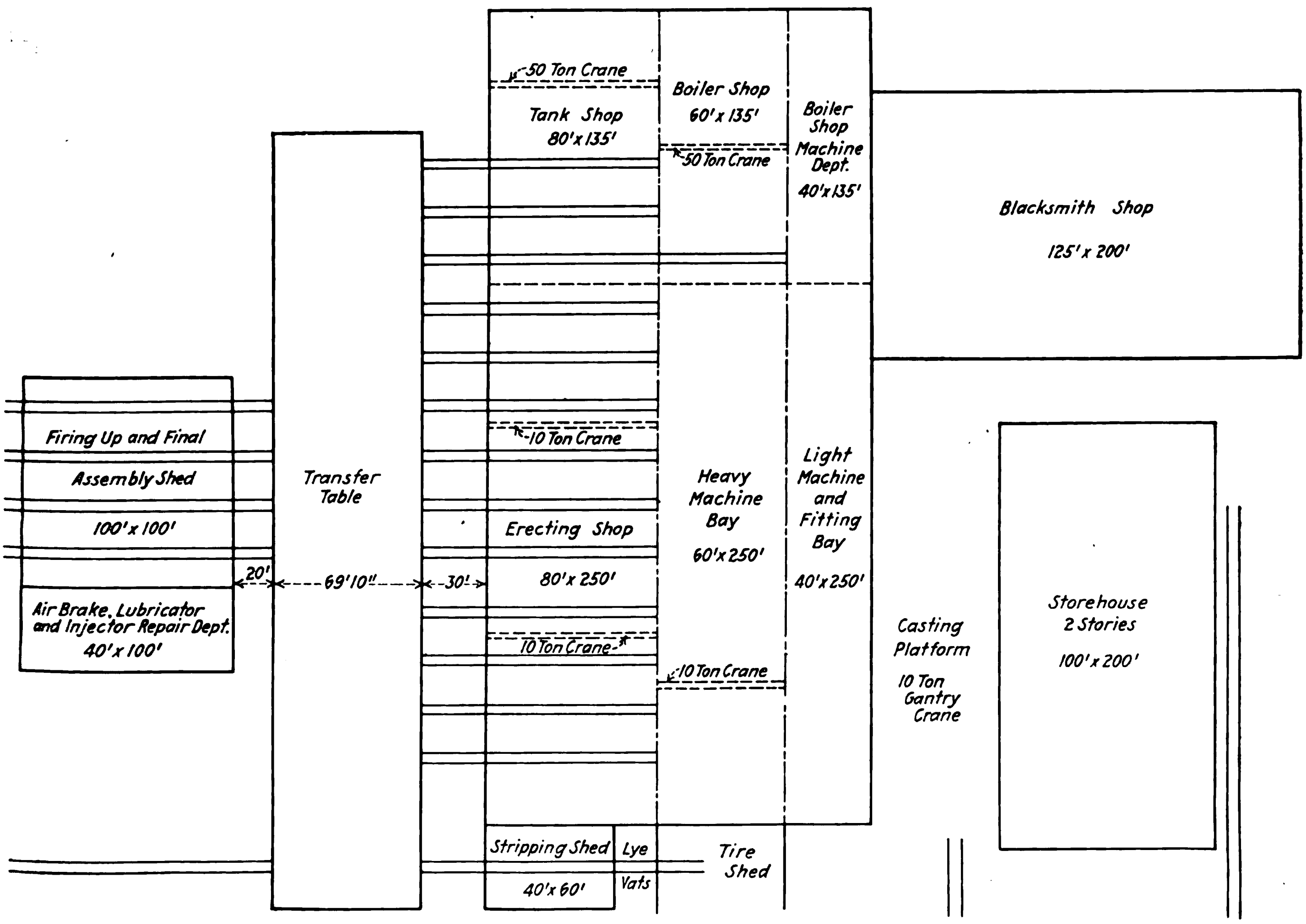
All material disbursements should be made by the stores department direct to the machine or locomotive or other designated place for its delivery. A desirable system of ordering material would be to employ the telephone with instruments conveniently located for the foreman. This places the responsibility for the proper charging out of any material on the dispatching clerk in the storehouse. At the same time he could issue the necessary order to a material runner who would either deliver the material or see that it was placed at the loading station for the next electric delivery truck.

Transverse Shop the Most Serviceable

Let us consider the shop itself. Where sufficient ground area is available, a transverse shop is perhaps the most desirable. This will permit the most economical construction inasmuch as it can be built without the necessity for installing cranes of large capacity.

A separate stripping shop should be located immediately adjacent to the erecting shop, preferably at one end. This segregates the dirt and confusion attendant upon stripping locomotives. It should be equipped either with two heavy cranes or a Whiting locomotive hoist for wheeling and unwheeling locomotives, also a 15-ton crane for removing heavy parts. Adjacent to the stripping shop there should be a lye vat of ample size to receive rods, driving wheels and even engine and trailer trucks served by the 15-ton crane. Distribution of clean material can be effectively made to all departments from the lye vat.

This arrangement requires the installation of sufficient 15 or 20-ton cranes in the erecting shop to obtain a flexible system of operation. Each erecting gang can be given its own crane. This also permits the construction of a more economical shop.



Tentative Layout of a Departmental Shop

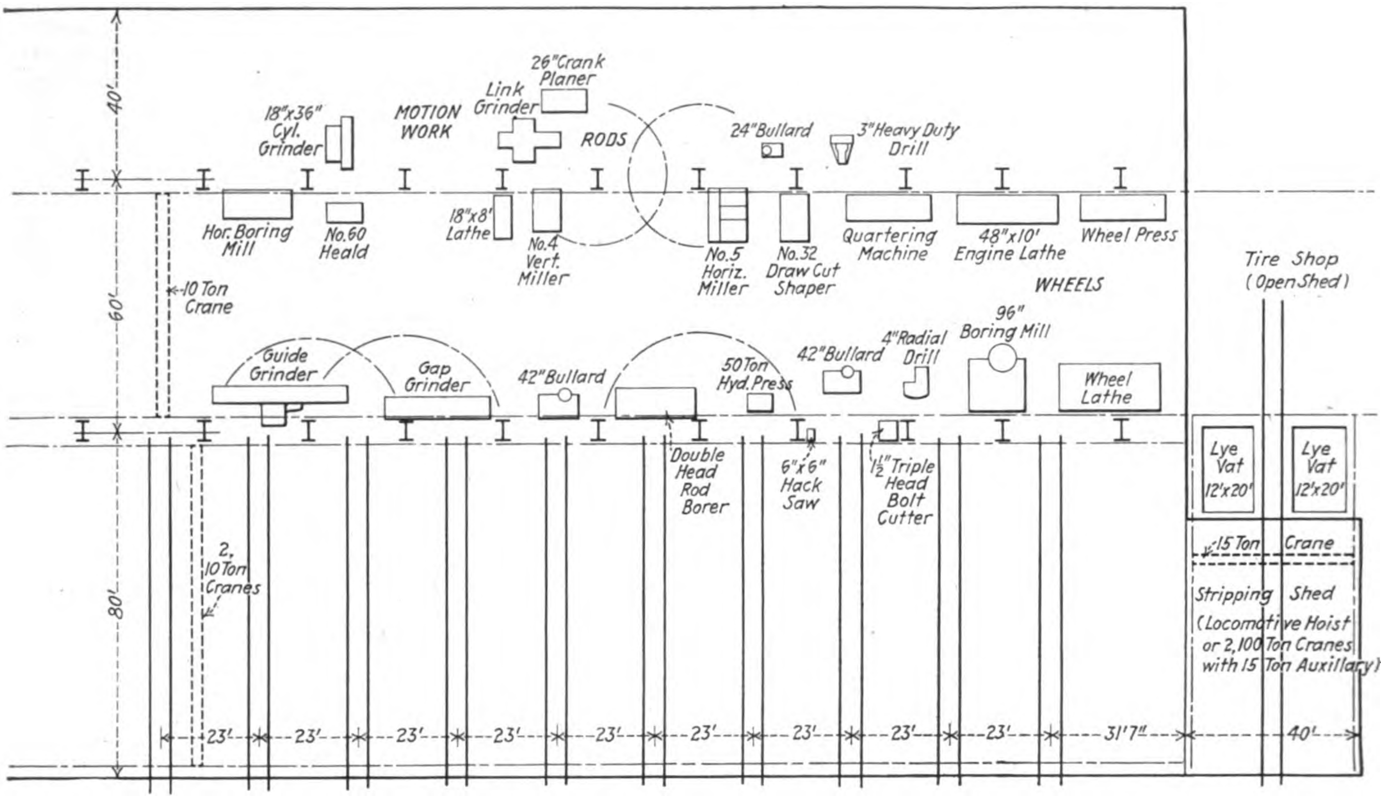
The departmental layout of such a shop should be such that all material can be moved without back tracking. A tentative layout of a transverse shop with 13 erecting pits is shown in the plan above. Where the output of the shop exceeds 10 engines, it will be necessary to provide an additional stripping track. This is essential so that the engine being stripped will not tie up the hoist except for wheeling and unwheeling operations.

The Fire-Up Shed

The firing-up and final assembly shed should be located adjacent to the air brake, lubricator and injector repair departments. These are the departments most concerned.

with the engine during the final assembly, and its subsequent fire-up test.

Another innovation that should be utilized in conjunction with the fire-up shed is a winch operated valve setting machine. Parts of valve gears should be carefully checked as to lengths and set. If they agree with the drawing requirements, it is only possible to alter or correct valve setting through altering the valve or eccentric rods in the case of outside valve gears. The best method of accomplishing this is by running over the valves of a locomotive while hot. A slow speed push button control, reversible electric winch with an endless cable, provided with chain loops for attaching to the locomotive can provide the motive power for the running over movement. The locomotive can be secured to this cable by means of turn-buckle devices, and moved over a distance of approximately forty feet. This should be more than enough for a complete revolution of any size of wheels. Limit controls could be utilized to prevent overrunning.



Arrangement of the Machine Shop and Erecting Shop With an Adjacent Stripping Shed

Straight Line Repair Shop

The straight line locomotive repair shop* would also be suitable for a repair shop of this character, provided a fire-up shed were placed at the end of the outgoing track with sufficient switches to permit the handling of engines on several tracks at this point. The fire-up shed should have the air brake, injector and lubricator departments placed as previously described.

Longitudinal Erecting Shop

A longitudinal erecting shop with one running track only could be substituted for the transverse shop. Stripping could then be done at one end of the shop and assembly done at the other end, with a fire-up shed for final assembly and test. Engines undergoing repairs would be set off at a slight angle supported on built-up structural steel pedestals to permit the removal of flues and their application. The use of pits in an erecting shop floor, either the transverse or longitudinal type is not required, except in stripping and assembly work. Otherwise, pits are apt to become a catch-all as well as an obstruction in the floor. They also tend to absorb light that otherwise might be reflected against the under portion of the locomotive on the pit.†

The equipment and scope of repair operations in an intensively operated locomotive repair shop are shown in the table. This also gives the proportion of a month's operation which the repair requirements for each engine will demand from each machine. This analysis is not to be considered as absolutely accurate, but represents the best possible study for repairing parts for heavy Consolidation or Mikado type locomotives, with new parts secured from a manufacturing shop.

Separate Organization for Manufacturing

The manufacture of locomotive and car repair parts, that are not commercially standard products can only be handled economically by an entirely separate organization. The equipment required for quantity production is different from that demanded for the repair of parts in small quantities. The attitude of the management in quantity production must be totally different from that required to cope with the problems of repair work.

Every part that can be completely finished ready for application or can be partly furnished and produced in quantity should be made in such a manufacturing or centralized production shop. Care should be taken, however, not to encroach upon the realm of commercially standard products. The manufacturing shop usually keeps a record of disbursements indicating the consumption at various points for all its products and also maintains an inspection organization capable of looking after manufacturing inspection, and also following up the kind of service rendered. A railroad,

*The straight line locomotive repair shop referred to here was described in the October 27, 1923, number of the *Railway Age*, page 767; the October 1923, *Railway Mechanical Engineer*, page 714.

†An erecting shop of the type referred to herein was described in the September, 1923, *Railway Mechanical Engineer*, page 615.

through this service, is in possession of a very valuable adjunct in effecting a reduction in the cost of maintenance of equipment. Control over the use and consumption of material and the knowledge of its performance should be available both for the mechanical and the stores departments. This is an invaluable aid in securing economy.

Analysis of Shop Operation

Based on General Repairs to Consolidation or Mikado type locomotive. Shop working eight hours per day

Operation	Repairs per engine: Pairs	Repairs per engine: Pieces	Average time per piece: Hr.	Average time per piece: Min.	Time: Hr.	Time: Min.	Proportion months operation Per Cent
Stripping Shop							
Engine stripped complete. All material cleaned and distributed	..	..	..	..	..	..	..
Erecting Shop							
Frame jaws squared, frame bolts renewed, shoes and wedges laid out, pedestal binders refit, cross braces rebolted if necessary	..	..	..	..	..	..	..
Spring rigging applied	..	..	..	..	..	..	..
Cylinders rebored, valve chamber bushings rebored or applied, guides lined, pistons applied and heads up	..	..	..	..	..	..	..
Engine wheeled and rods applied	..	..	..	..	..	..	..
Motion work applied, valves set and reverse gear up	..	..	..	..	..	..	..
Steam pipes, dry pipe, throttle and exhaust pipe applied. Superheater units and header applied and tested	..	..	..	..	..	..	..
Front end netting applied	..	..	..	..	..	..	..
Cab valves and fittings overhauled and safety valves set	..	..	..	..	..	..	..
Stoker applied, if used	..	..	..	..	..	..	..
Running boards, cylinder and dome castings, smoke box front applied	..	..	..	..	..	..	..
Air pump, reservoirs, brake cylinders and brake rigging applied	..	..	..	..	..	..	..
Jacket and lagging applied	..	..	..	..	..	..	..
Piping applied	..	..	..	..	..	..	..
Ashpans applied	..	..	..	..	..	..	..
Engine painted and lettered	..	..	..	..	..	..	..
Wheel Work							
Driving wheel tires turned	..	..	..	..	..	..	..
Crank pins quartered or new pins applied	..	..	..	..	..	..	..
Driving journals trued	..	..	..	..	..	..	..
Engine truck, trailer truck and tender truck tires turned, if steel	..	..	..	..	..	..	..
New wheel centers, crank pins and axles from manufacturing shop. Wheel centers should be turned and faced to standard, tires bored standard and lipped possibly at main shop. Crank pins finished complete except wheel fit	..	..	..	..	..	..	..
Engine truck, trailer truck and tender truck wheels mounted at main shop together with car wheels	..	..	..	..	..	..	..
1 90-in. wheel lathe turning tires	4	..	1	30	6	..	..
Truing journals	..	4	2	30	10	..	8
Note.—Used also for quartering wheels unless quartering machine is provided.							
1 96-in. vertical boring mill							
Boring tires	..	1½	1	..	1	30	..
Wheel centers, if not produced at main shop	..	¼	8	..	2	0	1.75
1 Quartering machine							
Quartering wheels	..	1	3	..	3	..	1.5
See note, on 90-in. wheel lathe.							
1 400-ton wheel press mounting and dismantling wheels	..	..	..	..	..	..	..
Pressing in pins	..	..	..	..	..	..	..
Piston and Cylinder Work							
New pistons fit and applied	..	..	..	..	..	..	..
Grooves in old pistons trued up	..	..	..	..	..	..	..
Piston rods ground	..	..	..	..	..	..	..
Cylinder head joints renewed	..	..	..	..	..	..	..
Cylinder bushings fit	..	..	..	..	..	..	..
Piston rod packing applied	..	..	..	..	..	..	..
New cylinder heads, piston bull rings, cylinder head studs, cylinder packing and piston rods from manufacturing plant finished	..	..	..	..	..	..	..
Cylinder bushings and valve bushings bored, ports milled and rough turned from manufacturing plant	..	..	..	..	..	..	..
New cylinders, purchased or from manufacturing shop	..	..	..	..	..	..	..
1 Gap grinder. Grind piston rods	..	2	..	40	1	20	..
Grind driving axle wheel fits	..	¼	..	45	..	12	..
Grind engine truck wheel fits	..	¼	..	40	..	12	..
Grind tender truck axle wheel fits	..	½	..	40	..	20	..
Grind crank pin, wheel fits	..	1	..	30	..	30	..
Grind valve stems	..	..	..	45	..	..	..
Grind valve yokes	..	2	..	35	1	20	2
1 48 in. by 18 ft. engine lathe							
Return piston heads	..	2	1	45	3	30	..
Fit cylinder bushings	..	1	4	..	4	..	..
True piston head grooves	..	2	1	30	3	..	..
True lift shaft bearings	..	.2	..	40	..	2	..
True rocker arms, when used	..	..	..	..	..	..	..
True engine truck and trailer journals	2	..	1	30	3	..	..
Fit piston rods to crosshead	..	.3	1	15	..	24	7.1
1 42-in. vertical turret lathe							
Fit piston heads	..	.8	1	30	1	12	..
Face cylinder head joints	..	.5	..	50	..	24	..
Fit valve chamber bushings	..	2.0	1	15	2	30	2
Piston Rod Packing							
Note.—See Cab Work.							
Valves and Valve Gears	..	..	..	..	..	..	..
Renew pins and bushings	..	..	..	..	..	..	..
Refit link and link block	..	..	..	..	..	..	..
Straighten valve rods and adjust to standard	..	..	..	..	..	..	..
Overhaul piston or slide valves	..	..	..	..	..	..	..
Overhaul reverse levers. Note.—Power reverse gear to air brake dept	..	..	..	..	..	..	..
Valve stem packing fitted	..	..	..	..	..	..	..
New valve gear parts, reverse lever latches, piston valve parts, valve packing rings, valve yokes, slide valves, valve strips, valve springs and valve stems from manufacturing shop finished	..	..	..	..	..	..	..
Motion work pins and bushings and eccentrics and straps, if used, from the manufacturing shop semi-finished	..	..	..	..	..	..	..
1 Internal grinder							
Grind bushing holes, motion work		12 holes	..	30	6	..	..
Grind knuckle pin holes in side rods		4 holes	..	45	3	..	4.5
1 18 in. by 36 in. cylinder grinder							
Fit motion work bushings	..	12	..	10	2	..	..
Fit motion work pins	..	14	..	15	3	30	2.75
1 Link Grinder							
Grind link radius	..	2	2	..	4	..	..
Grind link block	..	2	1	..	2	..	3.0
1 Guide grinder							
Re-surface guides	..	4	..	30	2	..	..
Re-surface slide valves	..	*2	..	..	..	..	..
Grind valve strips	..	*8	..	..	..	..	..
Re-surface pressure plates	..	*2	..	..	..	..	..
Total	..	..	..	..	..	..	*1.0
1 42-in. Vertical turret lathe							
Re-bore eccentric straps	..	*4	..	..	..	..	..
Return eccentrics	..	*4	..	..	..	..	..
True dome caps	..	0.2	2	..	..	24	..
Bore and face hub liners, driving boxes	..	8	..	45	6	..	..

*Only in case of old power.

Operation	Repairs: Pairs	Repairs: Pieces	Average time per piece: Hr.	Average time per piece: Min.	Time: Hr.	Time: Min.	Proportion months operation Per Cent
Engine truck center castings, rebored	..	.5	2	..	1	..	3.75
Valve stem packing bored	..	..	.	..	..	..	..
Note.—See Cab Work.							
Driving Box Work							
Driving box shoe and wedge ways brought back to standard	..	..	..	..	..	..	..
New driving box brasses applied and bored	..	..	..	..	..	..	..
Cellars refit	..	..	..	..	..	..	..
Hub liners, driving box, applied and faced	..	..	..	..	..	..	..
Spring saddle pockets, driving boxes milled	..	..	..	..	..	..	..
Oil grooves cut in driving boxes	..	..	..	..	..	..	..
New driving boxes complete ready for brass from manufacturing shop	..	..	..	..	..	..	..
1 4-ft. radial drill press							
Drill boxes for oil holes	..	..	..	..	..	..	..
Drill cylinder heads if impossible to drill standard at manufacturing shop	..	..	..	..	..	..	..
1 Draw cut shaper							
Plane shoes and wedges to line	..	8	..	15	2	..	..
Plane driving box brasses	..	8	..	20	2	35	..
Refit pedestal braces	..	8	..	30	4	..	..
Recut guide clearances	..	4	..	15	1	..	..
True driving box shoe and wedge ways	..	8	..	30	4	..	..
Fit driving box cellars (or preferably on guide grinder)	..	8	..	30	4	..	..
Square up spring saddles	..	8	..	15	2	..	9.75
Brasses bored and hub liners faced. Note—See vertical turret lathe, valves and valve gears	..	..	..	..	..	..	..
Frame Work							
Shoes and wedges planed to line	..	..	..	..	..	..	..
Pedestal braces refit	..	..	..	..	..	..	..
Frame braces jaws refit after closing or welding on new ends	..	..	..	..	..	..	..
Frame bolts fitted	..	..	..	..	..	..	..
New shoes and wedges from manufacturing shop	..	..	..	..	..	..	..
Bolts turned to taper and standard sizes from manufacturing shop and holes reamed for bolts	..	..	..	..	..	..	..

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Proportion months operation Per Cent
New frames and parts from manufacturing shop or frames preferably purchased already finished	..	..	..	..	..	..	..
Shoes and wedges planed and pedestal braces fit. Note—See draw cut shaper driving boxes	..	..	..	..	..	..	..
1 6-in. by 6-in. power hack saw—Cut taper bolts to length for threading	..	..	..	..	..	..	..
1 1½-in. triple head bolt cutter—Threading taper bolts after cut to length	..	..	..	..	..	..	..
Guide Work							
Guides straightened and ground	..	..	..	..	..	..	..
Recut guide clearances	..	..	..	..	..	..	..
New guides and guide blocks from manufacturing shop finished	..	..	..	..	..	..	..
Note.—See guide grinder, motion work and draw cut shaper, driving boxes.							
Spring Rigging Work							
Spring hangers and equalizers bushed	..	..	..	..	..	..	..
Spring saddles squared	..	..	..	..	..	..	..
New spring saddles, spring pins and clips from manufacturing shop finished. Springs repaired or new from manufacturing shop or purchased	..	..	..	..	..	..	..
1 3-ft. Heavy duty vertical drill							
Bore spring hangers for bushing (or after holes are plugged)		24 holes	5	..	5	..	..
Bore springs equalizers for bushing		12 holes	4	..	4	..	..
Bore brake hangers for bushings		16 holes	4	..	4	..	..
Bore and ream crosshead for pin fit	..	2	1	..	3	..	..
Ream for new crosshead shoes, if bolted		16 holes	1	..	1	..	8.5
Note.—See also draw cut shaper under Driving Box Work.							
Foundation Brake Rigging							
Brake rods and levers overhauled	..	..	..	..	..	..	..
Brake cylinder packing leather renewed and cylinder greased	..	..	..	..	..	..	..
Brake hangers overhauled and new shoes secured	..	..	..	..	..	..	..
New brake, rod jaws, adjusting rods, levers and hangers from manufacturing shop. Brake pins purchased	..	..	..	..	..	..	..
Note.—See 3-in. heavy duty vertical drill, spring rigging work.							
Crosshead Work							
Babbitt crosshead shoes for guides	..	..	..	..	..	..	..
Ream and bolt new crosshead shoes	..	..	..	..	..	..	..
Ream for crosshead pin	..	..	..	..	..	..	..
New crossheads complete from manufacturing shop and shoes complete ready to ream	..	..	..	..	..	..	..
Note.—See 3-in. heavy duty vertical drill, spring rigging work.							
Steam Pipes, Throttle and Superheater Work							
Steam pipe, dry pipe and exhaust pot joints ground	..	..	..	..	..	..	..
New joint rings, if necessary for steam pipes and dry pipe	..	..	..	..	..	..	..
Exhaust nozzle renewed	..	..	..	..	..	..	..
Superheater header and unit joints ground	..	..	..	..	..	..	..
Superheater units repaired	..	..	..	..	..	..	..
Throttle rigging overhauled	..	..	..	..	..	..	..
New steam pipes, exhaust pots, throttle valves, standpipes and throttle lever latches from manufacturing shop finished	..	..	..	..	..	..	..
1 horizontal boring, drilling and milling machine							
True up steam pipe joints	..	8	2	..	1	36	..
Rocker boxes rebored	..	.2	2	..	..	24	..
Rebore throttle box	..	.5	1	..	..	30	1.25
Exhaust nozzles ground from rough castings	..	..	..	..	..	..	..
Note—See grinder, valves and valve gears.							
1 6-in. by 6-in. power hack saw							
Repairs to superheater units	..	..	..	..	..	..	..
1 power pipe threading machine							
Repairs to superheater units	..	..	..	..	..	..	..
1 18-in. engine lathe							
Machine steam pipe joint rings	..	1	1	..	1	..	..
True up throttle valve seat	..	.3	1	30	..	27	..
Face crank pin nuts and washers	..	2	..	15	..	30	1
Rod Work							
Rods overhauled	..	..	..	..	..	..	..
New crank pin rod bushings applied	..	..	..	..	..	..	..
New knuckle pins and bushings fit	..	..	..	..	..	..	..
Rod straps, front or back solid end main rods milled	..	..	..	..	..	..	..
Rod brasses renewed	..	..	..	..	..	..	..
Bushings and brasses bored	..	..	..	..	..	..	..
New rods, rod straps, crank pin collars, wrist pin collars, rod dowels, rod wedges, oil and grease cup parts from manufacturing shop finished. Knuckle pins and rod brasses semi-finished. Bolts turned taper ready to thread, holes reamed to suit	..	..	..	..	..	..	..

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Proportion months operation Per Cent
1 No. 4 heavy duty vertical milling machine							
Mill driving box saddle pockets	..	4	1	..	4	..	..
Mill rod straps to true	..	..	..	..	..	..	..
Mill solid end rods to true	..	4	1	..	4	..	4
1 24-in. vertical turret lathe							
Fit rod bushings	..	8	..	20	2	40	..
Bore and face rod brasses	..	4	..	30	2	40	2.7
1 26-in. crank planer or No. 5 heavy duty horizontal milling machine							
Finish rod brasses for strap	..	4	1	15	5	..	..
Finish wheel keys	..	2	..	25	..	48	..
Finish eccentric keys	..	2	..	25	..	48	..
Finish frame keys	..	.4	..	30	..	6	..
Finish guide blocks	..	.8	1	..	..	48	..
Finish rod keys	..	2	..	30	1	..	..
True up engine truck boxes	..	2	..	30	1	..	..
True up engine truck pedestals	..	1	..	45	..	45	5.1
1 Double spindle heavy duty rod boring mill or heavy duty vertical drill							
Bore rod bushings	..	8	..	30	4	..	..
Ream for knuckle pins	..	4	..	45	3	..	3.5
1 50-ton hydraulic press							
Apply rod bushings	..	..	..	..	..	..	..
Apply driving box brasses	..	..	..	..	..	..	..
Air Brake Work							
Pump cleaned and overhauled	..	..	..	..	..	..	..
Engineer's valve cleaned and overhauled	..	..	..	..	..	..	..
Triple valves cleaned and overhauled	..	..	..	..	..	..	..
Power reverse gear overhauled	..	..	..	..	..	..	..
New parts purchased. Triple valves overhauled preferably at builders or manufacturing shop. Air pumps rebushed at manufacturing shop	..	..	..	..	..	..	..
Power reverse gear cylinder bored when necessary on horizontal boring mill, steam pipe work or ground, internal grinder, valves and valve gears	..	..	..	..	..	..	..
Cab Work							
Injectors overhauled	..	..	..	..	..	..	..
Lubricators overhauled	..	..	..	..	..	..	..
Cab valves overhauled	..	..	..	..	..	..	..
Automatic fire doors overhauled	..	..	..	..	..	..	..
Gage cocks ground and overhauled	..	..	..	..	..	..	..
Water glasses and cocks overhauled	..	..	..	..	..	..	..
Repair parts purchased, except railroad companies individual standard valves, parts of which are secured from manufacturing shop	..	..	..	..	..	..	..
1 No. 4 turret lathe with side carriage							
Repairs on cab valves, boiler checks, etc.	..	..	6	..	6	..	..
Bore piston rod packing		2 sets	..	15	..	30	..
Bore valve stem packing		2 sets	..	12	..	24	..
Wash out plugs rechased	..	9	..	10	1	30	4.2
Engine Trucks							
Engine trucks overhauled	..	..	..	..	..	..	..
New engine truck boxes and center castings from manufacturing shop finished	..	..	..	..	..	..	..
Engine truck boxes and pedestals trued	..	..	..	..	..	..	..
Note—See Rod Work.							
Engine truck center castings rebored	..	..	..	..	..	..	..
Note—See valves and valve gears.							
Miscellaneous							
1 Sensitive drill press							
Miscellaneous small drilling	..	..	..	..	..	..	..
Boiler and Flue Shop							
Flues							
1 Electric butt welding machine or rotary flue welding machine	..	..	..	..	..	..	..
Safe ending flues	..	..	..	..	..	..	..
1 Flue cutting off machine							
Cutting flues to length	..	..	..	..	..	..	..
1 Rotary swaging machine							
Swaging flues	..	..	..	..	..	..	..
Fireboxes							
Repaired and renewed	..	..	..	..	..	..	..
If justified, flues sheets and door sheets from manufacturing shop	..	..	..	..	..	..	..
Staybolts furnished in sets for new fireboxes, also for repairs from manufacturing shop	..	..	..	..	..	..	..
1 McCabe flanging machine							
If flues and door sheets are made in shop	..	..	..	..	..	..	..
1 6-ft radial drill							
Drilling flue sheets	..	..	..	..	..	..	..
Ash Pans							
Overhauled and new sheets and hoppers made	..	..	..	..	..	..	..
Ash pan rigging overhauled	..	..	..	..	..	..	..
General Equipment							
1 1½-in. single end throat punch	..	..	..	..	..	..	..
1 1½-in. single end throat shear	..	..	..	..	..	..	..
1 Bending roll	..	..	..	..	..	..	..

Tool for Flanging Collars on Copper Pipe

By E. A. Miller

A TOOL that has been used successfully in railroad shop work for flanging collars on copper pipe is shown in Fig. 1. This tool does away with the use of the common brazed and ground joint used on injector and other copper piping. It consists essentially of a vise in which can be fitted different sized dies, one of which is shown in Fig. 2. A separate die is required for each size of pipe. The die is placed in the vise as shown by the dotted lines in Fig. 1. Behind the die piece is placed a filling piece, which has an opening to permit the pipe to extend through. This filling piece is used for all dies up to 2¼ in. pipe size. Above the die is placed a top piece on which the clamping screw turns. The clamping screw has a square head with a 12-in. handle and is screwed through a bushing in the top piece of the vise. This bushing is keyed in place, and can be easily removed. The vise arrangement itself is somewhat similar in construction to the ordinary pipe vise used for holding pipe while cutting or screwing on fittings. The yoke containing the screw is held in place by two links, to one of which it is permanently secured by a pin and cotter. The other link is securely latched in place as long as there is a load on the screw, but very readily releases when the screw is slack.

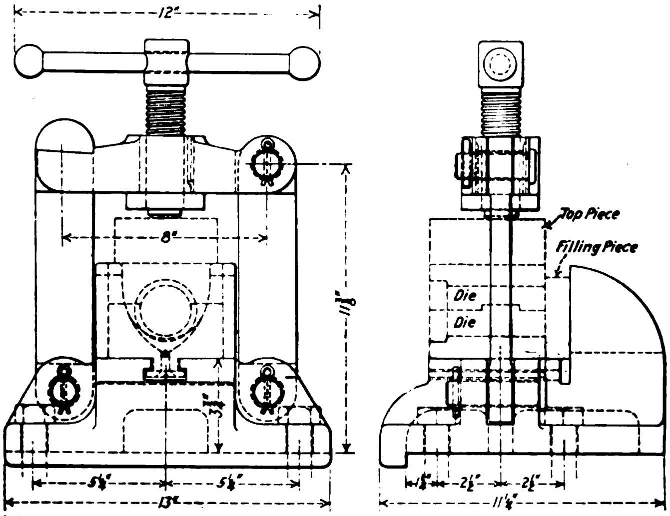


Fig. 1—Drawing of the Vise Showing the Die in Position

Size of Cu Pipe W. I. Pipe Sizes	Dimensions								
	A	B	C	D	E	F	G	H	I
3/8"	43/64"	1"	3"	5/16"	29/64"	2 3/4"	1 3/16"	1 1/16"	1/4"
1"	1 5/16"	1 5/8"	3 1/2"	5/16"	1/2"	3 5/8"	1 9/16"	1 9/16"	1/4"
1 1/4"	1 21/32"	2 1/4"	3 1/2"	1/4"	25/32"	4"	1 3/4"	1 3/4"	3/16"

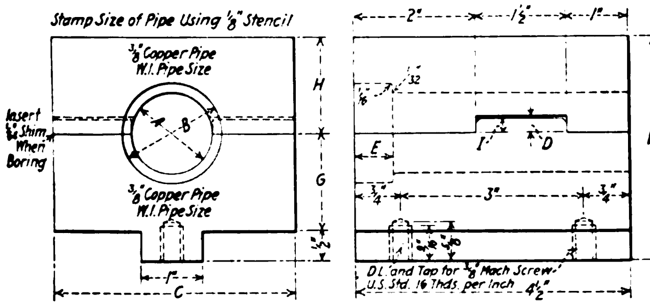


Fig. 2—Details of the Die Used for Holding the Pipe

The work to be done consists of four different operations. First, the pipe to be flanged is placed in the hole in the vise and then clamped securely. The end of the pipe is annealed. It is clamped in the die flush with the face to obtain the required material for gather. The second operation consists of expanding the end of the pipe. This is done by means of an expanding tool, of which there is one for each pipe size. Where this device is being used at the present time, there are ten different sizes of pipe to be taken care of. For these ten different sizes of pipe, there are, however, only two expanding tools needed, as one takes care of pipe up to and including 2 in., while the other takes care of pipe from 2¼ in. up to 3¼ in. inclusive. The third operation consists of the work of performing the actual flanging. A pneumatic hammer, in which has been inserted a die of the proper size, one of which is shown in Fig. 3, is used to do the work of flanging the pipe. During this operation the die should be rotated while driving with the air hammer. Upon the completion of the work of flanging, the fourth operation is performed, which consists of annealing the pipe.

It will be noted in Fig. 1 that provision is made for taking up the force of the blows of the hammer by a bracket on the base of the vise and the filling piece, which is inserted between this bracket and the die. The flanging dies are made of forged steel and are casehardened. The pneumatic hammer dies are made of tool steel with from 0.8 per cent to 0.9 per cent carbon and are heat treated. In order to distinguish the difference in the sizes of flanging dies and also of the pneumatic hammer dies, the size of the pipe for which they are to be used is stamped on them.

Collars for 2½-in. outside diameter copper pipe have been formed in 1½ min., leaving the collar in such shape as to require no subsequent machining to get a tight joint. This method is much quicker than the old method of turning up a brass joint, brazing it on the pipe and then grinding it in.

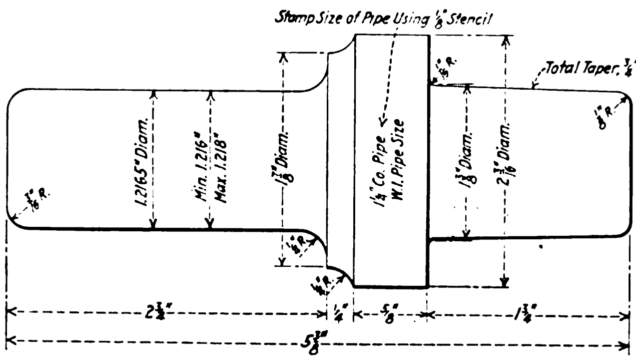
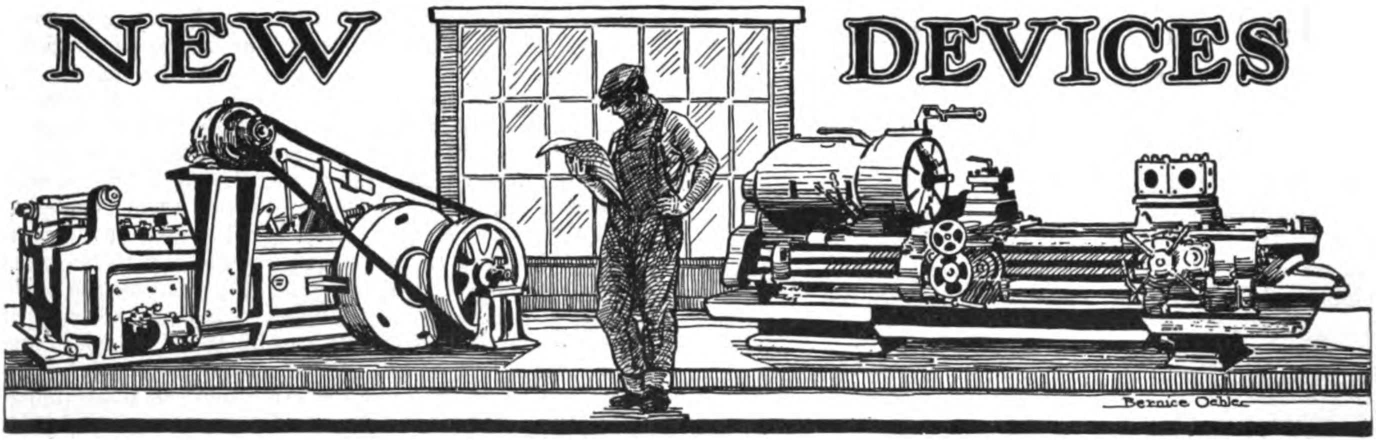


Fig. 3—Pneumatic Hammer Die for 1¼-Inch Copper Pipe

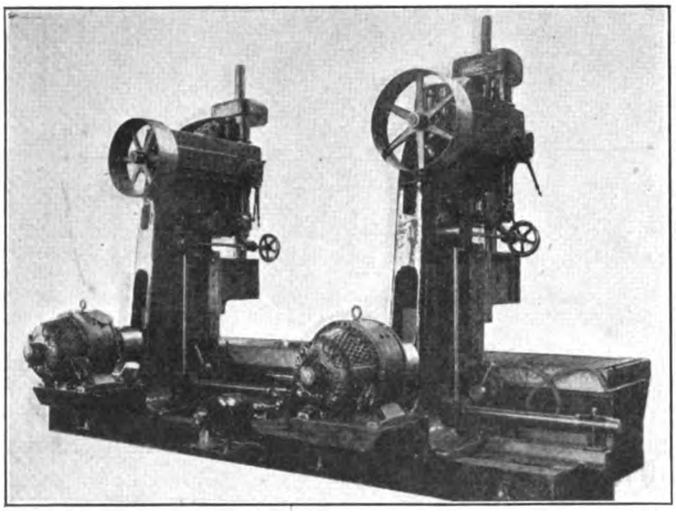
Thermit Preheater Burners

IN conducting some recent extensive experiments with different types of burners to be used in connection with standard Thermit preheaters' The Metal & Thermit Corporation, New York, found that the best results were secured with a burner pipe ⅜ in. in diameter, swaged down at one end and then drilled with 2 5/16-in. holes. Such a burner pipe fully atomizes the fuel before it enters the mold and gives the best combustion. When larger burners are used, or when ends are not swaged down, considerable air and fuel is wasted. The fuel does not become fully atomized with the result that raw oil is carried into the mold or is wasted by dripping from the end of the pipe.



Locomotive Rod Boring Machine

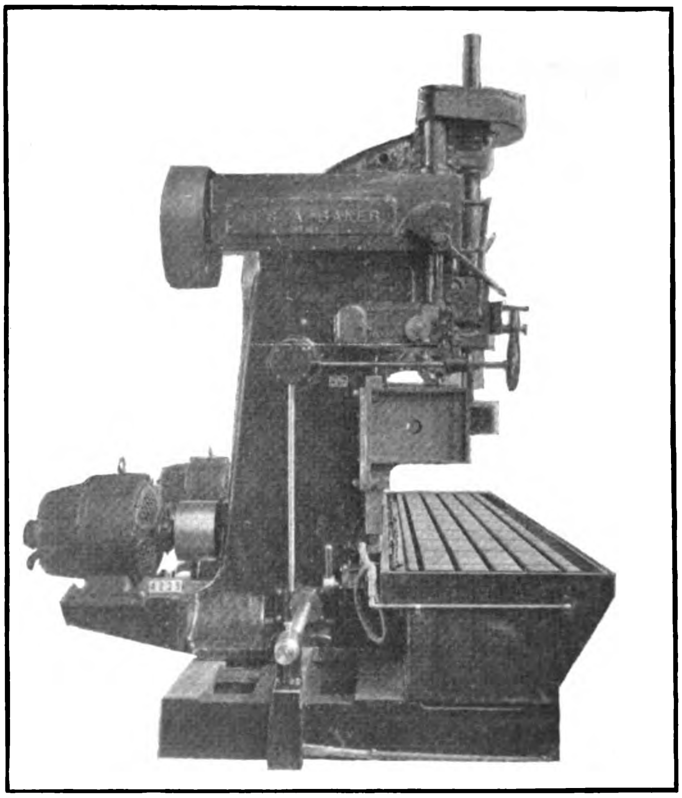
A TOOL designed to meet the needs of an extra stiff machine for boring outside rods, levers and heavy work of similar nature, has recently been placed on the market by Baker Brothers, Toledo, Ohio. It is a development of similar types covering a number of models built during the past 15 years. This development has resulted in a simple, rugged and efficient machine, which, while massive, is easily controlled. Particular attention has been paid to this feature in the design of this machine. Speed and feed changes can be made instantly. Each spindle is driven by a 15 hp. motor running at 1,200 r.p.m., constant speed. Where at all possible, the use of direct current is recommended. When direct current is used, the machine should be equipped with a series contactor, self-starter with a push button start, stop and reverse. This makes a much better arrangement and provides for tapping oil cups. Where alternating current only is available, a tapping reverse can be incorporated mechanically.



Rear View Showing the Separate Drives for Each Unit

This machine has ample capacity to drive 5-in. high speed drills to the limits of their efficiency in steel. It is well adapted for heavy rapid boring, drilling, forming and facing. It can be used for boring and enlarging in steel and cast iron up to 14 in. It is equipped with a constant speed drive through a train of hardened gearing, running on annual ball bearings that are encased in an oil-tight box. No friction bearings are used.

Speed changes are obtained by means of sliding gears and can be made instantly. Only the minimum number of gears are running in mesh at any one time. The simplicity of the drive is one of its special features. There are no overhanging brackets or levers of complicated design either inside or outside of the gear box. The spindle is made of forged high carbon steel and is fitted with special chrome ball-thrust bearings. The spindle nose is bored for No. 6 Morse taper. It is slotted across the end for driving, boring and facing the heads and fitted with a cross drift for holding these heavy tools securely. In addition, it has a hollow set screw to prevent light tools from dropping out. The machine is equipped with a spindle fitted complete ready for any type of work.

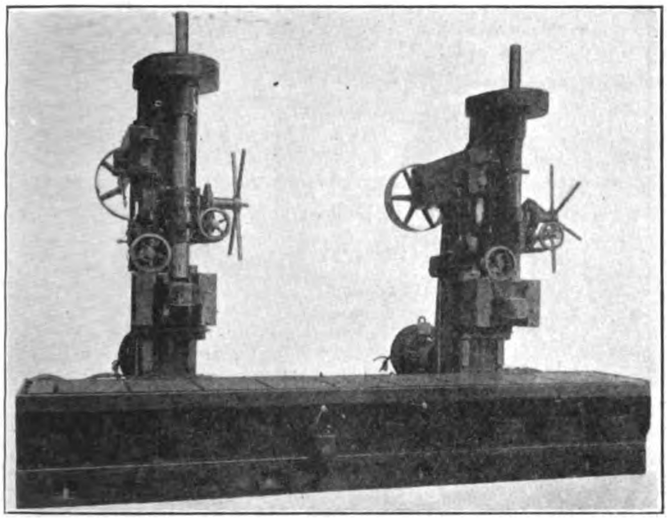


Side View Showing Method of Supporting the Boring Bars

The feed is provided with twelve drilling and twelve reaming feeds, twenty-four in all. The feed rack is of steel and the feed pinion that meshes with it is cut directly

on the shaft. Both units have independent drives and can be used with different speeds and feeds on different operations, if necessary. A large bronze worm gear is used for securing uniform wear and is secured to the shaft with a safety shear pin. This pin is set to shear at 14,000 lb. Capstan handles are provided for rapid traverse and in addition a hand worm feed is available.

The table is made up of a box section heavily ribbed, provided with heavy T slots, and has an oil tank extending its entire length. There is also a deep substantial groove for returning the cutting lubricant. A slot extends through the center of the table, in which are located two adjustable gibbed supports for the lower end of the boring bars. The boring bars are held by a rigid support, as shown in the side view. This support is adjusted vertically upon the gib ways by means of a handle. It consists of taper bushings, made adjustable for wear and assures rigid support of the boring tool directly above the work, eliminating any vibration and chatter. This permits the very heaviest feeds to be used. These supports can be used together or independently, making the machine practically universal for fitting in with the boring bar equipment. This makes the machine especially adaptable to meet the demands of different railroad shops.



Front View of Machine Tool for Boring Outside Rods

Each frame is an independent unit and is adjustable along the base either by hand or by power. A small motor is used for traversing the frames along the base. The frames are locked into position by air locks and the controls for both traverse and lock are located in front of the machine. All gears are completely guarded.

The specifications of the machine are as follows: Capacity of the high speed drill in solid steel is 5 in.; the distance from the center of spindle to the face of column, 18 in.; the distance from end of spindle to table, 30 in.; length of feed, 18 in.; diameter of spindle sleeve, 5.25 in., and least diameter of spindle, 3 5/16 in. Width of the steel feed rack, 2¼ in. The driving gear has a 2¾-in. face and is 18⅔ in. in diameter. There are twelve drilling feeds, .006, .007, .008, .010, .012, .013, .015, .017, .020, .028, .032 and .034, and twelve reaming feeds, .020, .023, .027, .033, .038, .044, .050, .057, .066, .081, .094 and .108. The minimum and maximum centers of spindle are 3 ft. 4 in. and 12 ft. 6 in., respectively. Eight speed changes, 11, 16, 20, 27, 61, 87, 111, 151, are provided. The driving pulley is 24 in. by 7½ in., and runs at a speed of 600 r.p.m. Two 15 hp., 1,200 r.p.m., and one 2 hp., 1,200 r.p.m., motors are required to operate the machine. It occupies a floor space of 8 ft. 0 in. by 17 ft. 2 in., and has a net weight of about 35,000 lb.

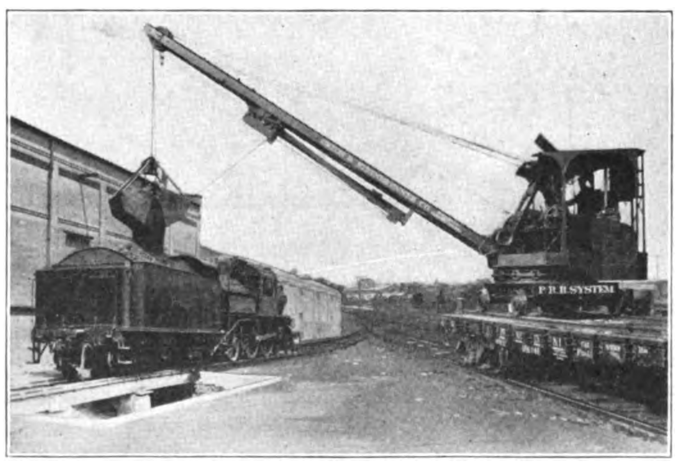
Small Crane for Railroad Service

The light, general-purpose crane illustrated is now being produced by the Orton & Steinbrenner Company, Chicago, for use about railroad shops, enginehouses, scrap docks, yards, etc. It is designed for mounting on a flat car traveling the length of the car, revolving in a full circle, and yet keeping within all railroad clearances. The length of the boom is 28 ft., which enables it to be shipped anywhere on a 40-ft. car.

The crane is equipped to handle with equal facility, hook, bucket or magnet. The maximum capacity is seven tons at 12 ft. radius; or it will handle a ½- or ¾-cubic yard bucket with the boom extended to 28 ft. radius; or a 36-in. electro-magnet handling a length of 130-lb. rail, weighing 1,430 lb., at the maximum radius. The wheels of the car are spaced 6 ft. 6 in. on centers, thus giving a wide base for stability. The boom measures 28 ft. 0 in., center to center, thus providing long enough reach to unload rails from a car in front or in back of the crane car, on the same or an adjacent track.

Power is furnished by a four-cylinder, 5-in. by 6½-in., heavy-duty gasoline motor, with high tension magneto. This motor is geared directly to the hoisting, swinging and traveling gears. It is operated by one man only. A generating set, belt-connected to the engine, furnishes current for a 36-in. electro magnet. This device is valuable in handling magnetic materials such as rails, switches, frogs, truck side frames, wheels, etc. Bucket handling drums are also furnished on the machine. A ¾-cubic yard bucket will hold on an average one-half ton of coal, and at a rate of two trips per minute, the machine will handle about 30 tons of coal an hour. As an emergency locomotive coaler, this crane can therefore be used to advantage. At the maximum radius, that is, 30 ft. from the center of the machine, the crane can handle 4,400 lb.

A separate shaft with two niggerheads, is supplied on the front of the crane. These are useful in pulling cars and dragging in loads to a position where they can be handled on the boom. The novel feature of this crane is its movability, both over a division and on its own car. Moreover, being gasoline motor driven, it is always ready for service without any preliminary firing, nor is any trouble encountered from bad weather or lack of ready coal supply.



Orton & Steinbrenner Gasoline Motor-Operated Crane Coaling a Locomotive

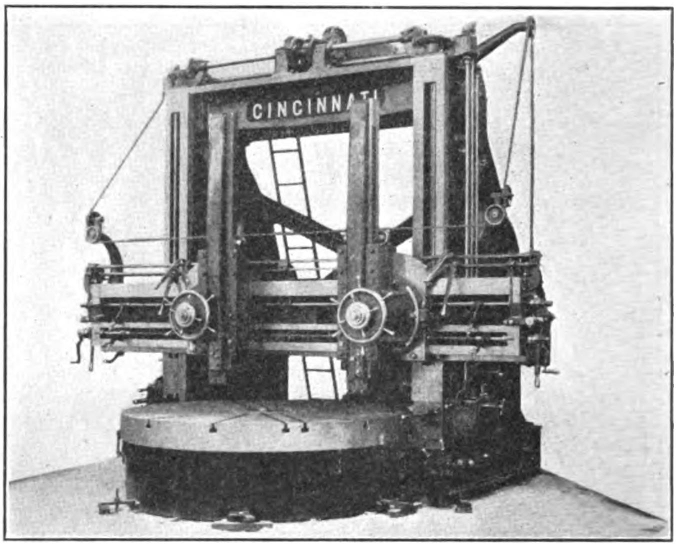
New Eight-Foot Massive Boring Mill

A SPECIAL 8-ft. massive boring mill with features of the design differing from the ordinary mill, has recently been placed on the market by the Cincinnati Planer Company, Cincinnati, Ohio. The table is driven by a bevel gear. The pinion that meshes with this gear, which is belted to the table, is supported on both sides and is a separate unit from the drive gear box. The upper spindle bearing is adjustable to compensate for wear.

When used with a variable speed motor, the drive gear box has four speeds. It has nine speeds when used with a constant speed motor. All the gears are of steel and the shafts are made of high carbon steel bearing in bronze bushings. The motor is mounted on top of the gear box and is geared down to the drive shaft. Speed change levers for operating the table changes have been placed directly at the operator's side which makes the machine easy to operate and facilitates faster production.

The housings, which are higher than those ordinarily used, are bolted, dowelled and tongued to the extension and tied together on top by a heavy box arch. This is done in order to eliminate all vibration. X-braces are also used to assist in firmly holding the housings. The heads are of special design, as can be seen in the illustration. The handle wheels are equipped with hand feed and lock, which can be operated to feed and lock without exertion. The rams are made extra long and the steel racks are bolted to them to allow for easy replacement. The feed and rapid traverse are controlled from the side of the head so that when using the head in the center of the table the control levers are within reach of the operator. Sensitive handles are also provided to permit the tools to be easily set.

The feeds are obtained through an all-steel gear box that provides eight different feeds. This box has a vertical tumbler arrangement which automatically locks itself when placed in the correct position. Centralized control has been developed to such an extent that no matter what the operator is doing, he can reach any lever desired. The rail is raised and lowered by an elevating device that has positive clutches, with the addition of a safety friction clutch. The rail is prevented from rising beyond its maximum height by a limit stop that automatically throws out the clutch.

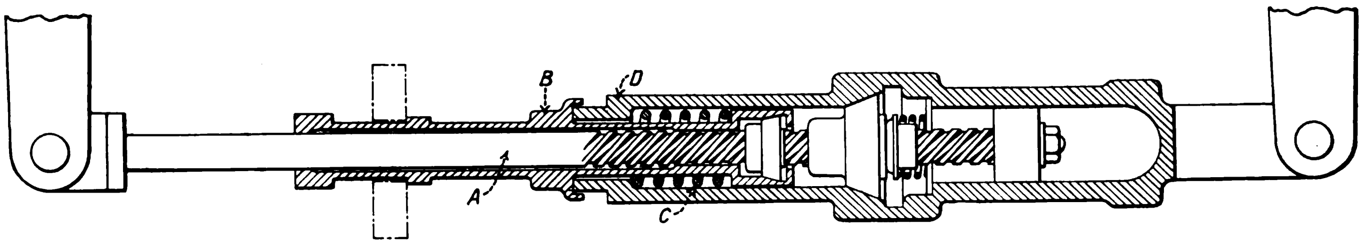


A Double Head Boring Mill of Massive Design

The A. L. M. Slack Adjuster

A NEW type of slack adjuster has recently been developed and is now undergoing a trial on the Metropolitan Railway, Paris, France. This device is known as the A.L.M. slack adjuster. It has also been successfully used in Europe on street cars, automobiles, elevators and hoists.

With few exceptions, all slack adjusters now in practical use depend on a step-by-step action in the form of a ratchet or some equivalent, such as shims, and consequently do not take up the slack as soon as it is formed, but only after it has been developed to a certain degree. The A.L.M. type of slack adjuster differs from this type in that it takes up the slack immediately on the first application of the brake after this slack has developed. It also has the advantage of being entirely enclosed so that the main sleeve body can be filled with grease. This tends to prevent deterioration of the working parts.



Sectional View of A. L. M. Slack Adjuster

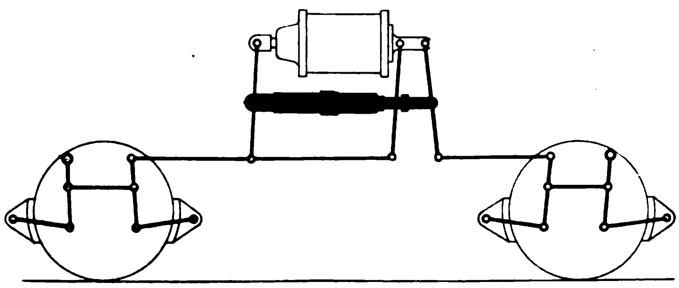
Referring to Fig. 2, the principal operating part consists of a high pitched screw *A* on which two nuts travel. The actual operating nut is provided with a conical outer surface, which corresponds to a conical seat in the main sleeve body *D*. Another nut is also provided with a conical surface on the outside which seats in a corresponding cone surface on the inside of the auxiliary sleeve *B*. This auxiliary sleeve slides inside the main sleeve and is held in position by means of a spring *C*. Both the main sleeve *D*, and the auxiliary sleeve *B*, are provided with a back stop, which engages the main and auxiliary nut, respectively, when either of these are moved by the action of the screw. The operating force is applied directly to the main sleeve. The brake lever is connected to the screw rod, through which the force is transmitted through the main sleeve, nut and screw to the brake rod.

The principle of the adjuster is based on the relative move-

ment of the brake rod and screw, which are directly connected through the brake rigging to a fixed point on the truck. If there were no wear, this movement would be constant and would correspond to the clearance between the brake shoes and wheels. As soon as wear has taken place, this relative movement will be increased. By arranging the stops on the auxiliary sleeve to allow for a movement corresponding to the normal brake shoe clearance, the auxiliary sleeve is prevented from following the movement of the screw as soon as it exceeds the normal clearance. The auxiliary sleeve is forced to move with the screw and main sleeve, thus the spring *C*, is gradually compressed. During this movement between the screw and the auxiliary sleeve, the auxiliary nut is released from its conical seat and moves up against the back stop. This prevents the nut from following the screw any further. On account of being free from its conical seat, it is at liberty to turn and move up the screw as long as the screw turns. When the brake is released again, the auxiliary nut immediately seats itself in the auxiliary sleeve and is thus prevented from turning back. Consequently the screw is locked in its new position and since the movement of the auxiliary sleeve is limited by the stop, the brake shoes cannot move away from the rims of the wheels any further than the normal clearance. In this manner the wear is taken up by the auxiliary nut.

This movement has not shortened the total length of the adjuster. When the auxiliary sleeve has stopped in its return movement, the main sleeve has still a certain distance to go before reaching the normal position of the main and auxiliary sleeves. An interposed spring consequently causes the main sleeve to continue its return movement, which releases the main nut from its seat in the main sleeve. It is thus required to travel up the screw just as far as the auxiliary nut was forced up the screw during the time the brakes were applied.

By dividing the slack-taking into two distinct steps, one between the brakes and the other between the wheels and the end of the adjuster to which the force is applied, it is possible to bring about the adjustment in infinitestimal steps, without the need for any external trip arrangement which usually requires a special design for each particular type of truck. G. S. Albanese, New York, has the United States patents on this device.

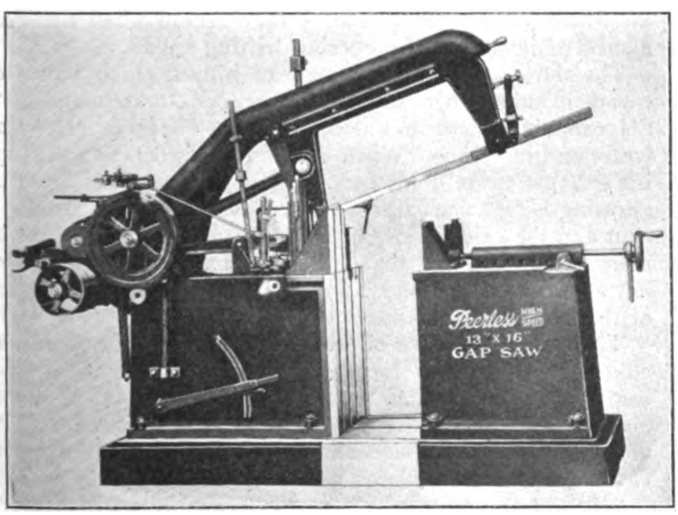


Arrangement of Brake Rigging Showing Application of Slack Adjuster

New Type of Power Hack Saw

A NEW type of power hack saw, known as a gap saw, has recently been announced by the Peerless Machine Company, Racine, Wis. When the gap is open, it has an excess work holding capacity 24 in. in height and 16 in. in width. When the gap is closed, the saw can be used for ordinary purposes.

The work can be clamped either to the finished vertical face on the bed, where four T-slots are provided for clamping purposes, or directly to the base, where three T-slots give ample clamping facilities. The base has a trough extending entirely around its perimeter, which carries the coolant back into a reservoir located in the rear of the base. At this point a geared rotary pump forces the coolant up into the distributing pipe. The finished pad which is opposite the gap and located on each side of the base, is for the convenience of the operator when locating work that is to be clamped directly to the base. The left-hand edge of the bed is also finished for purposes of convenience in measuring when the gap is open for holding large pieces.



Hack Saw with Gap for Large Holding Capacity

A piece of steel 16 in. by 26 in. can be cut in two by sawing through 13 in. and then meeting the cut by turning the piece half way around. This type of work is often encountered in a railroad shop or drop forge shop where hammered forgings, such as are machined up into crankshafts, are often blocked out prior to the machining operations required to produce finished dimensions.

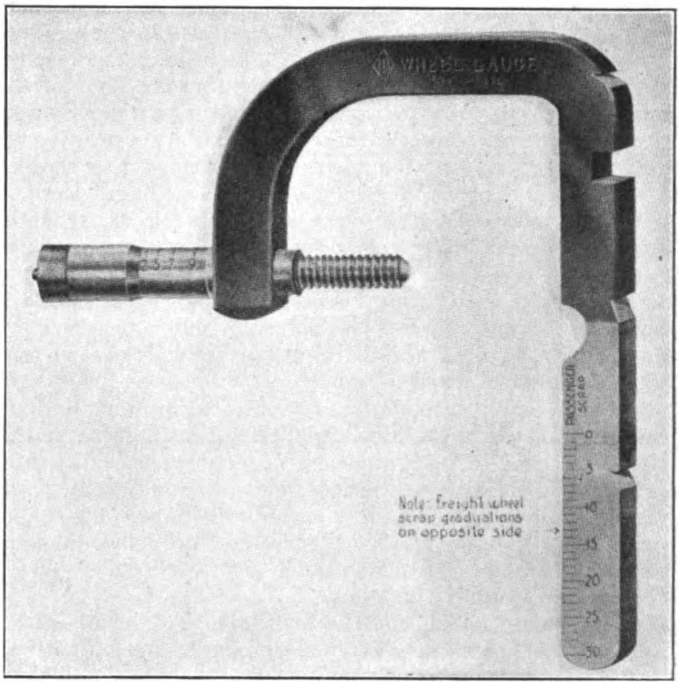
The head and feed mechanism is of substantial construction. The head lifts up on each return stroke and when the blade comes to the bottom of the cut, the feed is automatically disengaged. The head is then lifted up to its uppermost position through the usual arrangement of balance springs. The blade pressure or feed can also be varied at will by raising or lowering the ratchet lever on the side of the head shown in the illustration.

The machine shown in the illustration is equipped with the standard six-speed stroke mechanism, which is commonly used on Peerless high speed saws when the materials to be handled require different cutting speeds. Either this attachment or a two horsepower motor can be used with this machine. The general specifications are: Capacity of machine on ordinary work, 13 in. by 16 in.; capacity of gap work, 16 in. by 37 in.; length of blade, 14 in. to 24 in.; length of machine, 80 in.; width of machine, 30 in.; weight of machine, approximately 3,000 lb.; distance from the floor to the top of the base, 6 in.; distance from the floor to the top of the table, 30 in.; shipping weight, approximately 3,500 lb.; number of strokes per minute of the saw frame, 125.

Steel Wheel Gage with Micrometer Attachment

A STEEL wheel gage, known as the I-D type, especially designed to meet the demands for a service metal gage of permanent accuracy to a fine degree, has been placed on the market by the Universal Packing & Service Company, Chicago. This gage is especially suitable for wheel shops, lathe men and inspectors. It is similar in design to the A. R. A. type steel wheel gage described in the December, 1923 number of the *Railway Mechanical Engineer.* As shown in the illustration, micrometer readings are inscribed on the top of the micrometer screw for convenience in reading. The micrometer sleeve, holder and screw are finely machined with a polished finish. This screw has a special alloy tool steel ball point to eliminate any inaccuracies due to contact wear. The body is of drop-forged steel, lacquered black, except the graduated part, which is polished.

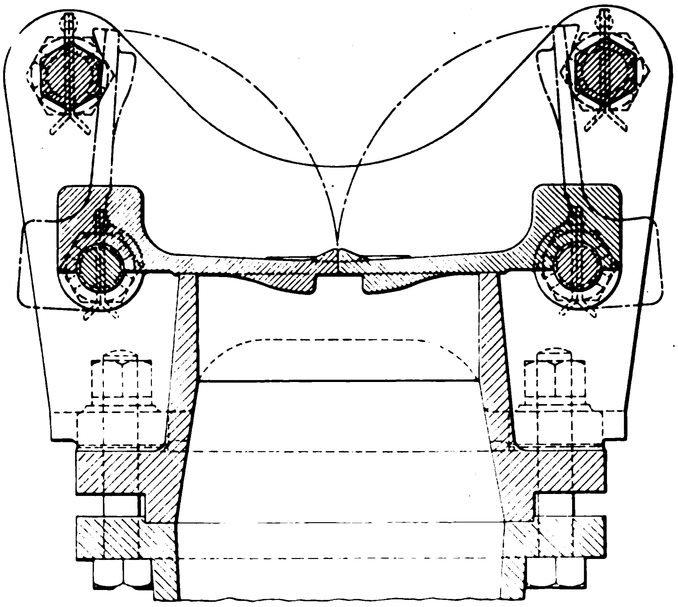
The method of using this gage is the same as that for the A. R. A. gage, except that the micrometer screw is used instead of the swinging finger. It provides a very accurate method of determining the tread thickness, the amount of material to be removed to restore the A. R. A. standard contour, the service metal remaining after the contour is restored, whether worn wheels are fit for further service or should be scrapped, the limit of depth and location of witness grooves in flanges, the limits of slid flat and shelled spots, vertical flanges, chipped rims, the limit of wear on journal collars, and a coupler gage.



The I-D Micrometer Wheel Gage

Automatic Exhaust Nozzle Cover

TO overcome carbonization in locomotive valve chambers and steam cylinders, the Detroit Lubricator Company, Detroit, Mich., has placed on the market the Detroit automatic exhaust nozzle covers. These covers are designed to provide a simple and inexpensive device which,



Sectional View of Exhaust Nozzle Cover

without resort to drifting valves, will protect the cylinders and parts exposed to steam pressure and consequently increase the life of cylinders, valves, bushings, piston rings, rods and packing.

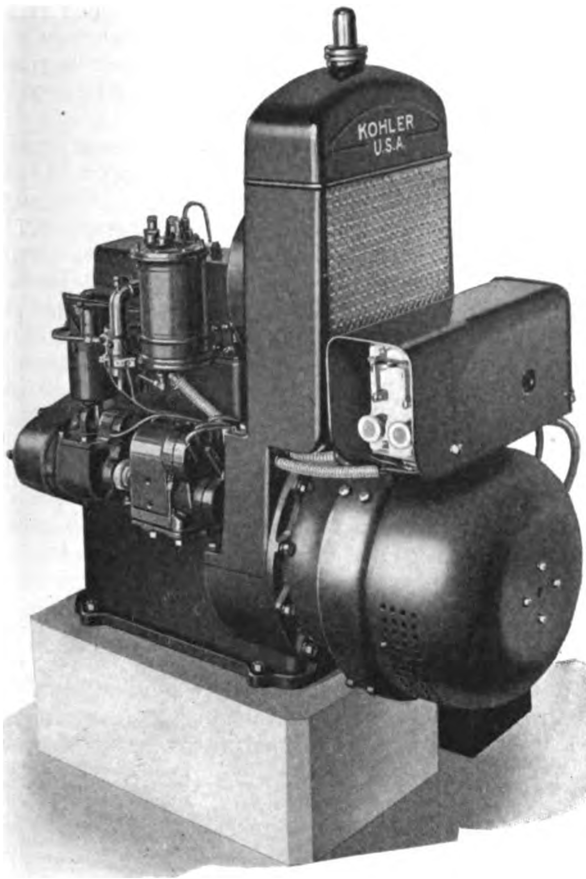
When steam is shut off and a locomotive is drifting, a partial vacuum is created by the movement of the pistons which acts to draw cinders and hot gases from the smokebox through the exhaust passages and into the valve chambers and steam cylinders. The heat burns the oil and destroys the lubrication on the walls while the cinders act as an abrasive to cut the packing and piston rings and produce carbonization which plugs up the passages. This is so generally recognized that engineers often drift with the throttle cracked open to destroy the vacuum when the locomotive is not fitted with special drifting valves.

The device consists of a pair of hinged clack valves or covers mounted in a suitable framework for attachment to the exhaust nozzle in the smokebox. These covers swing freely on hinge pins. When the engine is working the escaping exhaust steam holds the covers in an open position, thus allowing a free discharge. Immediately after the throttle is shut and the exhaust stops, the covers automatically close by their own weight and seal the nozzle against the entrance of hot smokebox gases and cinders to the valves and cylinders of the locomotive.

The covers are made of steel castings with their faces machined to fit the top faces of the nozzle tips. The hinge bearings are designed to prevent any accumulation of dirt or cinders from interfering with the free and automatic action of the covers. The side frames supporting the covers are steel castings arranged for mounting on the nozzle by bolts or studs. These frames carry the hinge bars and stops to prevent over-travel of the covers. In the majority of cases the framework is so designed that it can be attached by bolts or studs in the same location as the bolts for holding the tips onto the nozzles. As the design of exhaust nozzles and tips varies considerably on different locomotives, special patterns of covers and frames are furnished to suit the different requirements.

Car Lighting Plant of Unusual Design

A LIGHTING plant that has the unusual feature of automatic operation is being successfully used by several western railroads. This plant, with a 2,500-watt, 110-volt direct-current generator, independently driven, was installed in a gasoline motor coach for the Chicago & North Western, described in the October number of the *Railway Mechanical Engineer*. A rail motor car similarly equipped, but with a 1,500-watt generator, is in operation on the Santa Ana branch of the Union Pacific. The car used is a McKeen motor car, which weighs 70,000 lb. It is driven by a 200-hp. (S.A.E. rating) internal combustion engine burning kerosene and has a seating capacity of 72. It was lighted originally with gas. To provide a better headlight and more convenient lights for interior lighting and for markers, the small lighting plant was installed.



The Lighting Power Plant Complete

No auxiliary storage battery is required for lighting with these plants, which are made by the Kohler Company, Kohler, Wis. Turning on the first light causes the generating plant to start automatically. Turning off all the lights causes it to stop. It consists essentially of a 4-cylinder, 3½-hp. gasoline engine driving a 110-volt, 1,500-watt direct current generator. The overall dimensions of the power plant are 14 in. by 31½ in. by 36 in. high. The engine is water cooled and is of the valve-in-head type. The bore of the cylinders is two inches and the stroke is three inches. A high tension magneto is used for ignition. A small 24-volt storage battery, which is kept charged automatically, is used for starting.

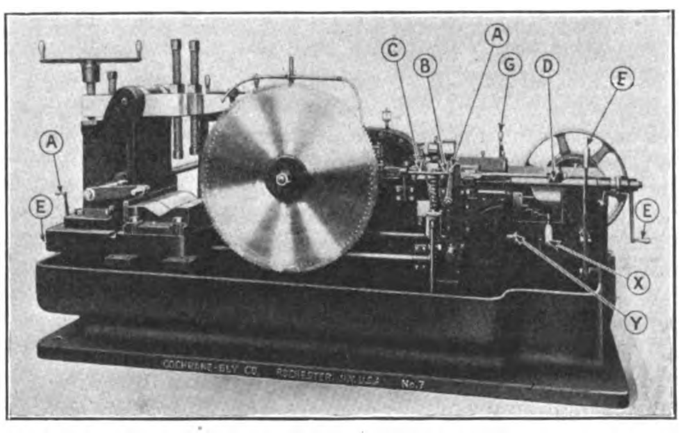
All circuits are controlled from switches on a panel in a metal cabinet in the operating department. When one of the lights on the circuit is turned on, the closing of the lighting circuit actuates a relay which operates the starting switch. Under light load the plant operates at a speed of about 850 r.p.m. When the load is increased, the plant automatically builds up its speed to take care of the load. The voltage remains practically constant at all loads and speeds. This is accomplished by an electrically operated throttling governor and special windings on the generator.

To provide for emergency, a 24-volt headlight lamp is carried in the car. If the 110-volt power should fail, the 110-volt headlight lamp would be replaced with the 24-volt lamp and the circuits are arranged so that the starting battery can be used to operate the headlight. The gas side lights have been left in the car for interior emergency light.

A New Metal Sawing Machine

THE Cochrane-Bly Company, Rochester, N. Y., has placed on the market a cold saw, having a capacity for cutting 13-in. round stock, 12 in. square, or 10-in. by 15-in. rectangular sections. The machine is driven by a friction clutch pulley, 24 in. in diameter by 9-in. face, and the drive shaft is equipped with ring oiling bearings. The pulley hub has an oil reservoir with a capacity for sufficient oil to last several months. The clutch is controlled by the levers *F* at either front or rear position. It has three cutting speeds, 30, 40 and 50 ft. per min. Changes are made by sliding a cone of gears on the driving shaft by means of a lever conveniently located on the outside of gear box as shown at *G*. All gears in the machine, except the worm gears, are made of steel, fully enclosed and run in a bath of oil. The miter gears on the drive shaft as well as the arbor gear and intermediate gear in the worm gear box, are of nickel steel and case hardened. The pinions meshing in these gears are of chrome-nickel steel and hardened. The worm gears are of phosphor-bronze. The driving worm is of hardened steel and is fitted with a heavy ball thrust bearing that runs in oil. This is an important feature as it tends to prolong the life of the bearing.

The bed of the machine is set in a deep pan, which catches the oil and chips. The oil drains into a generous reservoir to which a geared pump is connected. The bed is scraped to precision surface plates to create true surfaces to which the



Cold Saw Capable of Cutting 13-Inch Round Stock

saw carriage has been carefully fitted. The saw arbor is hardened and ground and fits into a solid bearing. There is no bolted joint in the carriage bearings to yield under cutting strains.

The feed screw is directly in line with the center of the saw arbor, and placed as close as possible to the saw blade. This brings the feed pressure as nearly as possible in line with the resistance of the saw. The nut on the feed screw is split and is adjustable endwise to take up all lost motion. Adjustable hardened steel nuts take up all lost motion between the screw and the gear box. The feed screw is driven by a worm, worm gear and compound spur gears. The tumbler *X* gives six changes, which are doubled by sliding gears *Y* that are in mesh with the gears on the worm shaft. The feed is started, stopped and reversed by the control lever *A* from either the front or back of the machine. A double pawl holds the clutch block in neutral position, engaged with the feed gear, or allows it to engage with the reverse gear, according to the position of the control lever. The pawls are lifted by means of a rack and pinion operated by the lever *A*. A movement of this lever to the left raises the feed pawl, tripping the machine into reverse, which automatically returns the saw carriage at a high speed to a point determined by the adjustable stop collar *B* on the trip rod *C*. The adjustable stop collar *D* lifts both pawls at the same time, automatically tripping the machine from feed to reverse. The control lever is moved to the right to release the reverse clutch and engage the feed clutch. The carriage can be adjusted to or from the work by the cranks *E* at either end of the machine.

The vise has double clamping screws to hold the stock at two points. These screws are hand operated. A vise with clamps operated by means of compressed air can also be furnished. A stock feeding device for pulling the bar through the vise by simply turning a crank is included with the regular equipment. The stock support carriage is moved by means of a chain, sprocket and crank, which is back geared to the sprocket shaft. One operator can easily adjust a 12-in. by 12-in. billet in the vise. The top of the yoke on the carriage is hinged and can be opened to facilitate placing the bar in the machine.

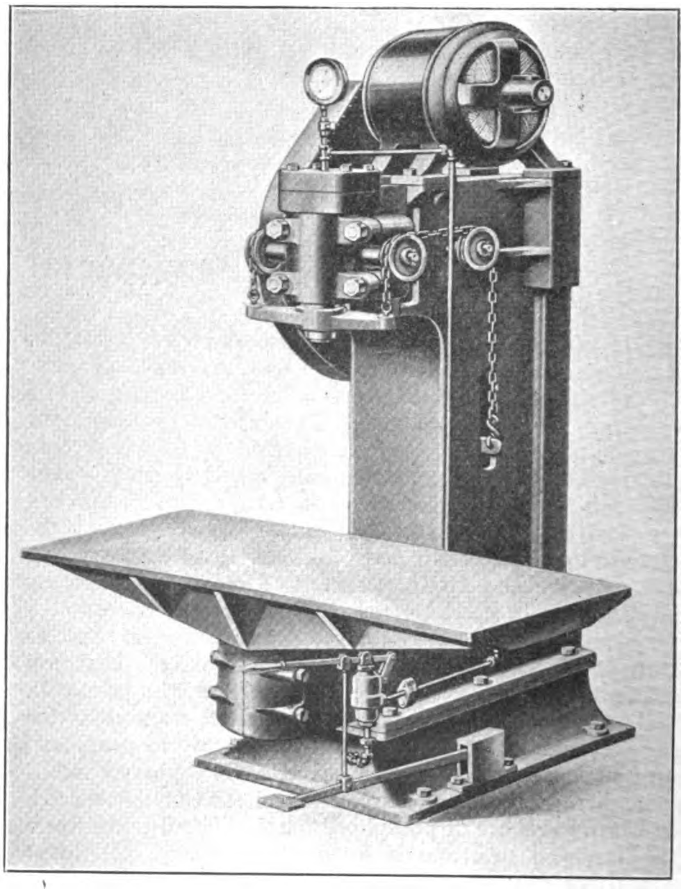
The machine has the following general specifications. Capacity: Round bars, 13 in.; square bars, 12 in.; I-beams, 18 in.; rectangular sections, 8 in. by 15 in. Capacity of 60 deg. fixtures for multiple cutting: ½-in. bars, 229; 1-in. bars, 53; 1½-in. bars, 26; 2-in. bars, 19; 2½-in. bars, 13; 3-in. bars, 8; 4-in. bars, 4; 5-in. bars, 4. The saw blade has a diameter and thickness of 37 in. and 9/32 in. respectively, and is mounted on a 6-in. mandrel with 9-in. collars. Eleven feed changes from ½ to 2½ in. per min. are provided. The work table is 24 in. high and has an area of 30 in. by 27½ in. The speed of the driving shaft is 300 r.p.m. A 20-hp., 860-900 r.p.m. motor is required. The belt and motor-driven machines occupy a floor space of 71 in. by 129 in. and 89 in. by 129 in., respectively, and have a net weight of 12,600 lb. and a crated weight of 13,200 lb.

Hydraulic Straightening Press

THE Watson-Stillman Company, New York, has recently brought out a rapid working hydraulic press for use in bending, straightening or forcing operations. It is designed to handle any work requiring pressure up to the full capacity of the press. It is a self-contained unit, being driven by a motor and requiring no auxiliary water or power supply. The operation is fast and under absolute control of the operator both as to speed and pressure. Movement of the ram is controlled by means of a valve operated either by a hand or foot lever. The pump is arranged so that the movement of the press ram through the idle portion of its stroke is very rapid and the change from low to high pressure for the actual straightening operation is effected automatically. A feature of importance is that the whole table can be removed. This leaves an open jaw forcing press that can be utilized in any kind of shop work, such as mandrel forcing, broaching, force fitting and assembling and many other kinds of work common to railroad shops.

The whole unit is built in a substantial manner, with all the working parts under detachable dirt proof guards. The frame is made of a steel casting with a copper-lined cylinder, bolted and keyed to the frame. The ram is made of high carbon steel. The base is of cast iron and serves as a reservoir for the pump. The pump body is of bronze and the plungers are of hardened tool steel packed with hemp under bronze glands. All packings are easily accessible. The pump valves are made of Monel metal and are of the metallic seated type. The ram is equipped with a positive stop to prevent over-stroke. This is an important feature considering the rapidity with which the press can be operated and provides an essential factor of safety.

Hydraulic pressure is used only for the pressure or downward motion of the ram; the return is accomplished by a counterweight inside of the frame. The illustration shows the press equipped with a slow speed motor with single reduction gearing to the pump shaft. A high speed motor can also be used, with compound gearing to the crankshaft.

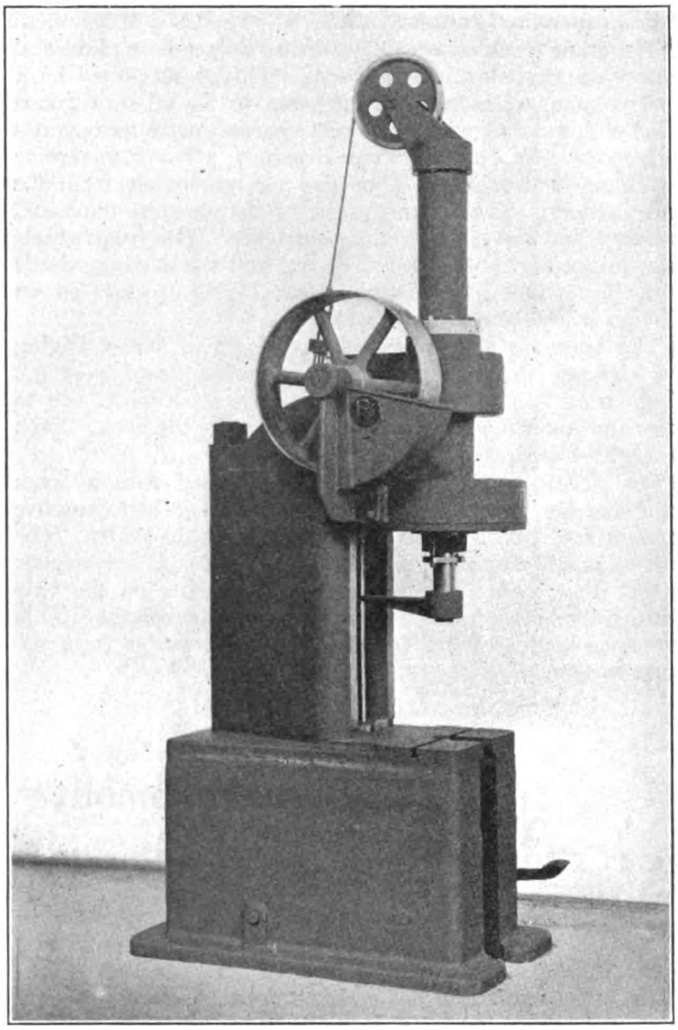


Rapid Working Press Equipped With Slow Speed Motor

New Flexible Power Press

A FLEXIBLE power press that combines speed of operation and adaptability to various conditions of operation is now available for railroad shop equipment. This machine can be readily adapted to such work as straightening shafts of all descriptions, bending, forming, assembling gears on shafts, pressing in bushings and bearings, burnishing holes to size and heading rivets cold. It operates under pressures varying from one pound to 20 tons and can be used for any job without danger of damage to the machine or tool. As shown in the illustration, the base of the machine is of heavy box type construction and down the front of the base, under the center of the ram, is a slot which permits flanged shafts, etc., to be placed on the work table. The top of the base forms the table. It also supports the column, which in turn supports a ram case heavily ribbed to withstand torsional strains. Heavy tie bolts fasten the table, column and ram case together in one solid unit. The ram is made of .50 per cent manganese chrome alloy steel, having a tensile strength of 135,000 lb. It has a quadruple thread of coarse pitch, which insures ample strength of the tooth section under all conditions. The ram is also provided with two opposed splined keyways for drive in rotation. The nose of the ram has a hardened steel thrust cap and also a special nose piece is provided so that a variety of form tools can be used on the end of the ram. The rotation of the ram is obtained by a steel worm driving a phosphor-bronze worm gear. The entire drive is enclosed in a grease case, insuring good lubrication.

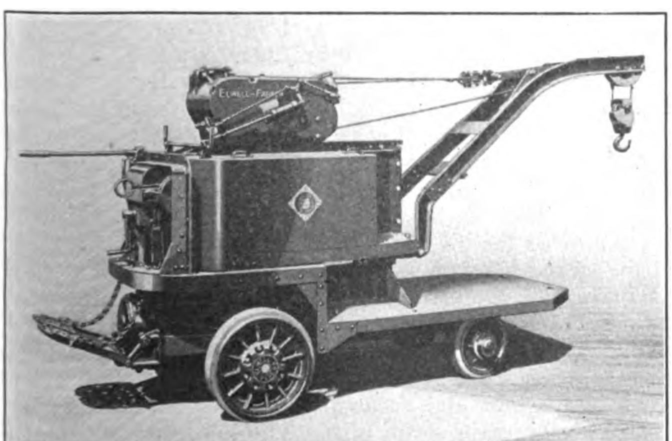
These presses are made in two sizes with a maximum pressure of 8 tons and 20 tons respectively. Both sizes are built practically to the same working dimensions. The maximum distance from the nose of the ram to the table is 20 in., the stroke of the ram is 18 in., and the height from the top of the table to the floor, 30 in. The ram travel for the 8-ton press is 155 in. per min. with a ram speed of 52 in. The shipping weight is 3,300 lb. The ram travel for the 20-ton press is 128 in. per min. with a speed of 32 in. Its shipping weight is 5,500 lb. These presses are built by the Fox Machine Company, Jackson, Mich.



Fox Flexible Power Press

Two New Elwell-Parker Trucks

TWO trucks designed for utility work around railroad shops and stores departments have been recently placed on the market by the Elwell-Parker Electric Company, Cleveland, Ohio. One of these trucks is an electric chisel truck designed to pick up objects set close to the floor and the other is a portable crane for handling the ordinary kinds of lifting work usually found around a railroad shop. The electric chisel truck carries the load ahead of the front axle on a platform or forks that can be lowered to touch the floor. The forks can be stopped at any desired height between the upper and lower limits, and may be so shaped at the outer ends as to be inserted beneath a bundle, box, casting or any irregular shaped piece weighing up to 2,500 lb.



Electric Portable Crane for Railroad Shops

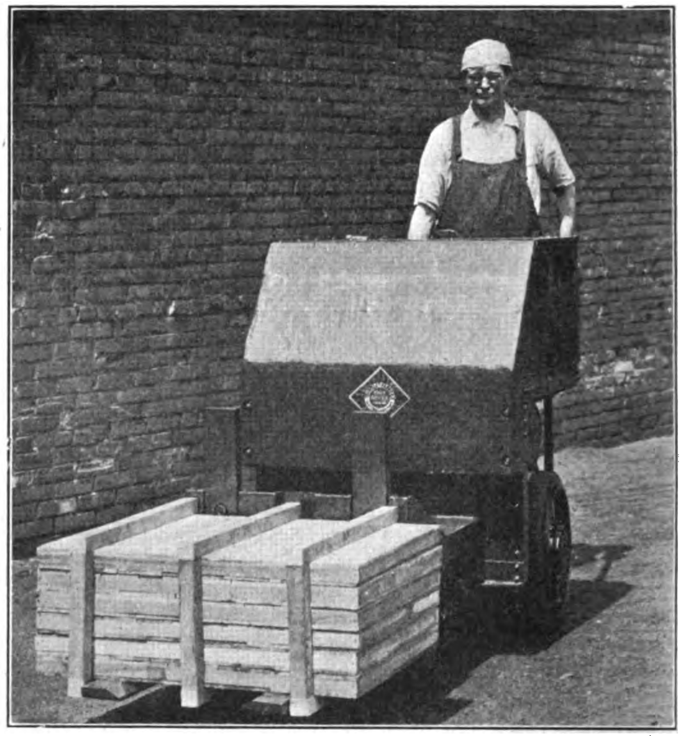
The length of the forks depends upon the weight carried, which is dependent upon the allowable loading of the front axle. The load handled balances an equal weight of the truck back of the front axle. This arrangement throws most of the weight on the front wheels. A special heavy axle with large, wide-spread roller bearings carries dual 10-in. by 3-in. rubber tired wheels. Both the front and rear wheels are used in steering. The knuckles are located close to the center of the tires. This assures easy steering and avoids any kick-back at the steering handle when the tires strike floor obstructions. The raising mechanism consists of a separate motor with worm gear reduction attached to a movable platen supported on the truck frame by means of three rocking links. This mechanism is simple in construction and is assembled as

a unit. The power or propelling unit in this truck consists of a heavy-duty motor and controller direct connected through a flexible coupling to a worm and wheel with a bevel pinion differential running in oil.

The crane truck consists of a lifting unit, power plant and battery counterbalancing the boom. This is supported on a steel column set in a base, anchored to an all-steel frame fitted with axles of wide gage. A separate controller operates each motor. Where the service demands, a motor to revolve the crane is provided. This also receives power from the same battery. The forward axle, or that nearest the hook, is heavy, and serves as a rolling outrigger. The front wheels are equipped with 15-in. by 3½-in., and the driving wheels with 22-in. by 4½-in. all-rubber tires. The truck steers on all four wheels and is easy to handle.

The hoist mechanism consists of a single motor driving two separate drums through worm gearing running in oil. Each drum is fitted with a ⅜-in. plow steel cable, one to raise and lower the boom, the other to handle the hook. Each is operated independently.

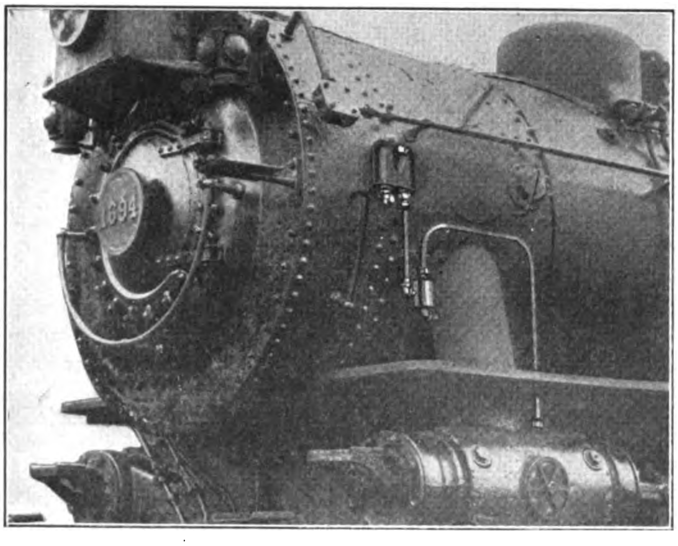
For stacking stores, the crane is provided with a boom somewhat shorter than that furnished for use in locomotive shops where it is necessary to reach up over the boiler. The unit is moved from point to point by means of an electric motor, direct connected through worm gearing on the axle beneath the battery and just back of the crane column. This motor, as well as the hoist motor, receives power from the same battery.



Oil Reservoir Is Attached to the Smokebox Above the Distributor

Bubb Locomotive Cylinder Lubricator

A POSITIVE and reliable lubricator for locomotive steam cylinders is being introduced by the Sheafe Engineering Company, Chicago. This device, known as the Bubb automatic lubricator, is extremely simple and is constructed along entirely new lines. It is entirely automatic in its operation, has fixed adjustment, feeds oil only when the locomotive is working and requires no attention aside from that necessary for draining and filling. Separate lubricators are furnished for the right and left-hand cylinders.



Oil Reservoir Is Attached to the Smokebox Above the Distributor

The lubricator includes an oil reservoir and a distributor together with accompanying parts and the necessary piping. The oil reservoir or lubricator body is attached to the smokebox at a convenient height. It is equipped with a filling plug, a drain cock and a mixer. This mixer, marked *A* in one of the illustrations, is screwed into the bottom of the lubricator body. It is hollow, has one small hole through the top and one or more small holes on the side near the top which determine the rate of speed and is provided with a pipe connection at the bottom. The head is ⅝ in. diameter, the section being somewhat reduced below this point. The mixer cap, *B*, which screws over the mixer, *A*, has one or more small openings near the bottom for the admission of oil to the small mixing chambers between *A* and *B*, as shown on the next page.

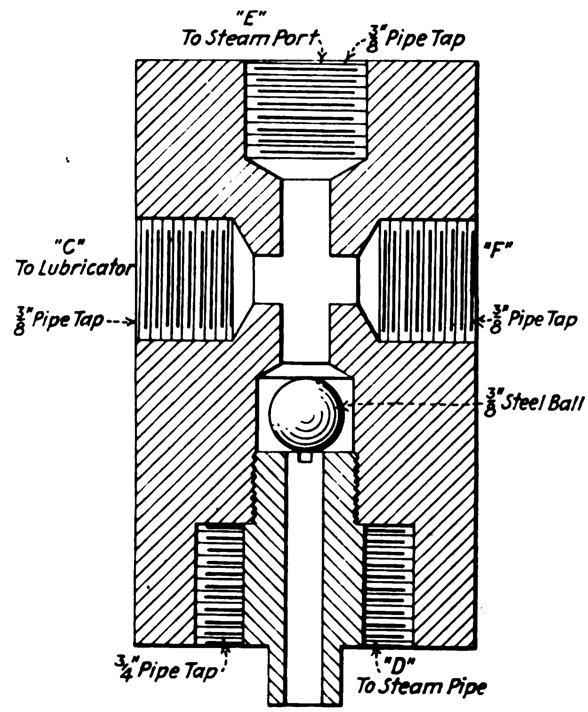
A ⅜-in. O.D. copper pipe connects the mixer to the side opening *C* of the distributor. The opening *D* in the bottom of the distributor is connected direct to the steam pipe, while the opening *E* on the top is usually piped to one of the steam ports leading to the locomotive cylinder. The other side opening *F* is usually plugged. The distributor contains a ⅜-in. steel ball, seating upward and kept in place by a hollow retaining plug.

While the throttle valve is open, there is always steam in the steam pipe and underneath the ball valve. At each stroke of the piston steam is also admitted through the main valve to the pipe connecting the top of the distributor to the steam port. At this time the pressure above and below the ball are equalized and the ball is off from its seat as shown. Steam then flows to the mixing chamber between *A* and *B* and emulsifies the oil therein. When the piston valve shuts off the steam, the pressure above the ball drops and it then seats upward. Emulsified oil now flows down the pipe from the mixer and collects above the ball, while fresh oil flows into the mixer chamber ready for the next admission of steam. When the flow of steam is reversed, the ball again drops and allows the accumulated emulsified oil to flow down into the main steam pipe. The lubricator starts and stops with the locomotive. The oil being completely emulsi-

fied promptly mixes with the steam. As the only moving part is a small steel ball, there is nothing to get out of working order.

Oil Reservoir with Mixer

The only way in which the rate of feed can be altered is to change the number or size of holes in the mixer or to put a choke plug in the outlet of the mixer. The latter is usually resorted to when the lubricator is used on switch engines.



Section Through the Distributor

This lubricator has been in successful operation on a number of locomotives for several months in both freight and passenger service. As shown, in the photograph of the front end of the locomotive, the oil reservoir is simply attached to the smokebox above the distributer. This location makes the device easily accessible at all times. This factor is important from the standpoint of the amount of time required in preparing the engine.

Unique Tractor Drive Increases Work Output

An internal gear drive for industrial tractors has been perfected by the Mercury Manufacturing Company, Chicago, and after three years of experimental operation, a new model—the Type H tractor—has been placed on the market in which this drive mechanism has been incorporated.

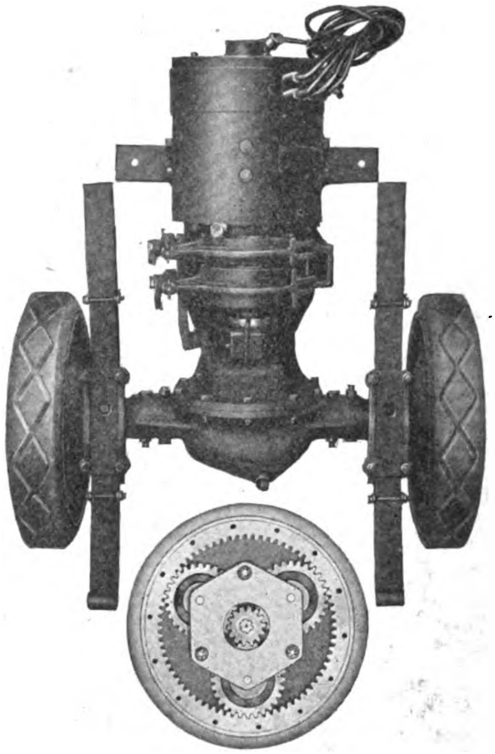
The most important advantage claimed by the manufacturer, on the basis of elaborate tests, is an increase of 25 to 35 per cent in mechanical efficiency, compared with the Type L tractor of this company, a worm-drive model. These tests showed, for example that at a 200-lb. draw-bar pull, the new model was developing an efficiency, indicated by speed and current consumption, 23 per cent greater than the Type L; at a 600-lb. draw-bar pull, 28 per cent; at 800-lb. draw-bar pull, 40 per cent, etc. This increase in efficiency means an ability to run longer on one charge, to handle heavier loads during the same length of time, or to reduce the amount of the charge without reducing the reserve capacity of the batteries.

According to reports from the manufacturer five tractors of the new internal gear drive which have been in experimental service for the last two years, have demonstrated high

The Type-H Mercury Tractor

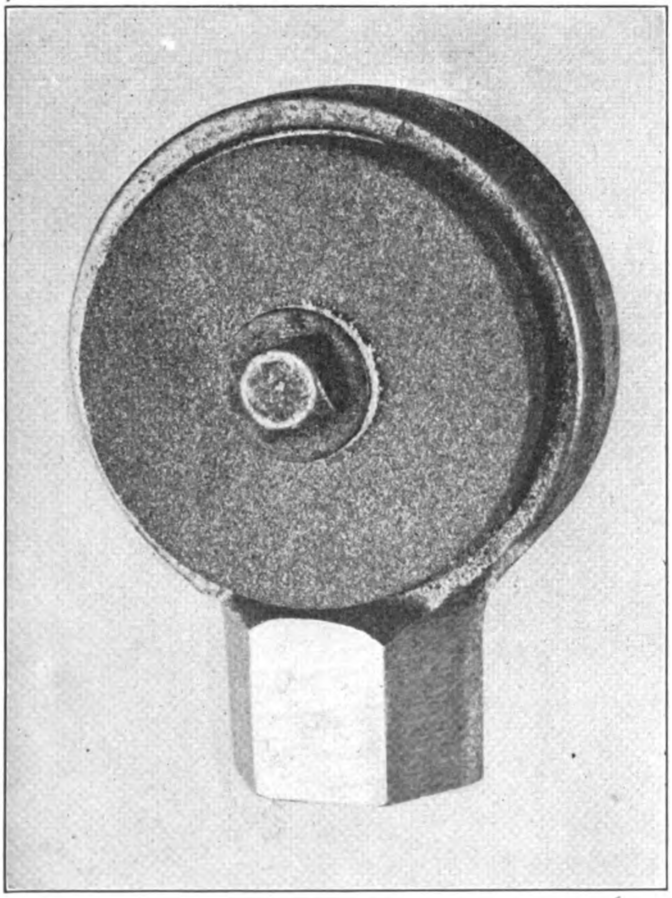
efficiency in maintenance as well as in operation. Thus far it has been unnecessary to replace any parts of the drive mechanism. The salient features of the new drive are the balanced arrangement of the driving gears within the wheels; the method used to position these gears in relation to one another; and the provision for an oil and dust tight enclosure for every moving part. The power plant comprising the motor, motor hanger, rear axle housing, rear wheels, rear springs and all driving gears, is assembled in a single unit which may be readily detached from the frame. The sequence of operation in this drive unit is as follows: The motor, joined to a pinion through a self-alining spring coupler, drives a bevel gear contained in the axle housing. This gear in turn drives the axle pinions to each rear wheel. The axle pinions transmit the power through three idler gears to a large ring gear mounted on the inner circumference of the drive wheels.

The motor is a high-speed, series-wound automotive type, its characteristics being adapted to the gear drive and battery assemblies used. The coupling between the motor and the driving pinion comprises four coil springs which cushion the initial starting torque, thereby allowing greater freedom of alinement, and eliminating much of the shock attending the operation of the machine. The frame, controller, safety features, wheel arrangement, etc., follow the lines which have been developed and used in the earlier designs of this company's equipment. The tractor has been used to very good advantage around freight houses for handling L.C.L. freight, storehouses and railroad shops.



The Power Plant and a View of the Internal Gear

Flue Gas Filter for CO_2 Equipment



Pyro-Porus Filter for Eliminating Fouling and Corrosive Gases

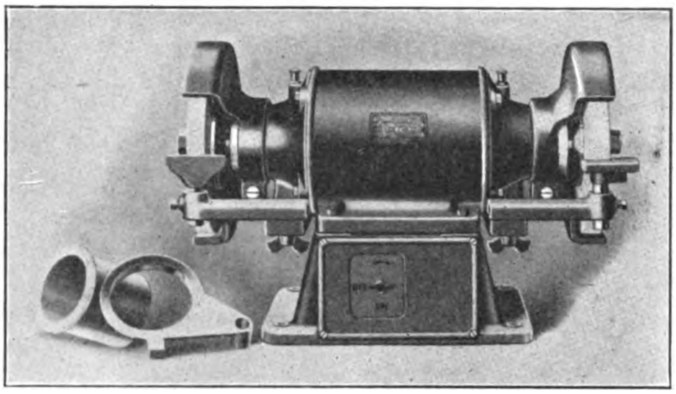
The Uehling Instrument Company, Paterson, N. J., has designed an attachment for the purpose of filter-flue gas for its CO_2 equipment. The filter consists of two porous disks held in a special casting by means of a bolt. The disks seat on asbestos gaskets and possess the necessary refractory qualities to resist the high temperatures ordinarily encountered. Aside from the reduction of attention required when using this improved method of filtration, there is the added advantage that a smaller size of sampling line can be employed because its entire cross-sectional area is effective when it is kept clean.

The filter, known as the Pyro-porus, is threaded for both a ¼-in. and a ¾-in. pipe. The preferred arrangement, however, is to withdraw the gas sample through an inner ¼-in. pipe and to utilize a ¾-in. outer pipe as a means for securely holding the filter in position. The majority of CO_2 recorders draw the flue gas through an open-ended pipe and filter through cotton waste or fabric. This necessitates more or less blowing out of the gas line with compressed air and frequent renewal of the filtering material. With the new method of filtration, the soot builds up on the filter and does not enter the pores to any extent, in fact this deposit of soot in itself is a good filtering medium. It is said that these disks are so effective that a piece of cotton placed in the gas sampling line will remain white indefinitely. Actual performance tests of these filters are also said to show that after continuous service for many months at a time, it is not necessary to have the sampling line blown out or to have the disks on the filter replaced, and no increased resistance to the gas flow is offered. The filter is placed on the inlet end of the gas sampling line and is inserted into the flue or last pass of the furnace. It is a big improvement over the old method of filtration and should result in a far more desirable gas sample.

Bench Grinder for Small Tools

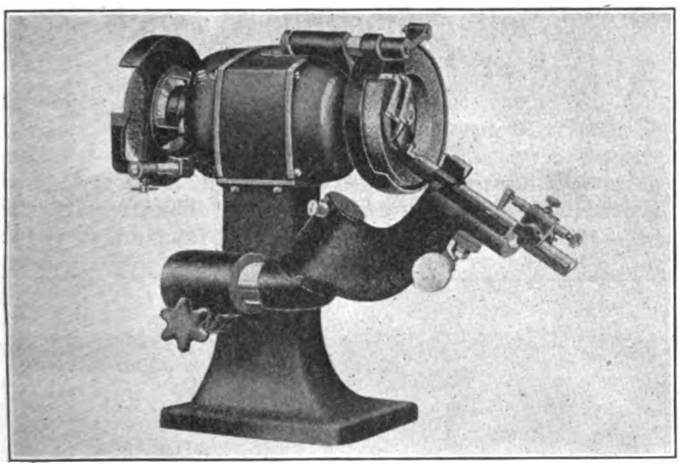
A BENCH grinder for grinding small tools is being manufactured by the Hisey-Wolf Machine Company, Cincinnati, Ohio. It is made in ½- and 1-hp. sizes. The grinding wheels are mounted directly on the spindle of the motor, which is furnished for either direct or alternating current. Ball bearings are used, mounted in the motor end caps in close proximity to the grinding wheels. All bearings are completely enclosed and are provided with heavy felt washers on each side of the bearing housing.

The motor is started by pressing a button located in front of the machine. The switch mechanism is in the base of the machine, to which easy access can be obtained by removing the cover plate. With the direct current motor, the ½-hp. machine runs at a speed of 3,000 r.p.m.; the 1-hp. machine at 2,100 r.p.m. The alternating current motor operates at a speed of 3,400 r.p.m. for the ½-hp. and 1,750 r.p.m. for the 1-hp. size. The grinder is provided with adjustable tool rests, detachable water pot and tool tray. It is equipped with steel wheel guards built to the standard dimensions and specifications recommended by the American Engineering Standards Committee. Coned shaped end heads and liberal wheel spacing provides liberal working space around the grinding wheels for two operators.



Hisey-Wolf Two-Wheel Bench Grinder

Bench-Type Twist Drill Grinder



A Bench Grinder for Twist Drills From No. 52 to 1¾ In. in Diameter

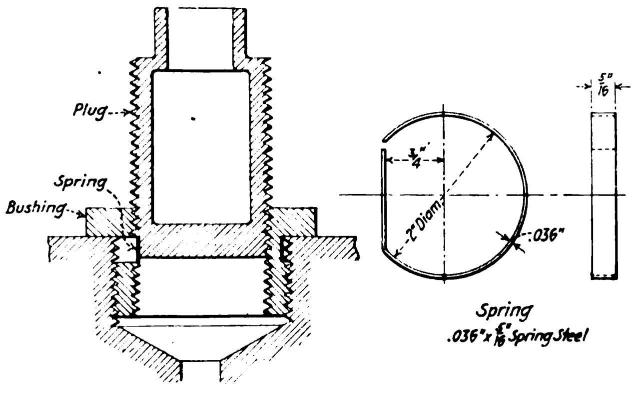
THE bench-type twist drill grinder illustrated is an interesting new development of the Gallmeyer & Livingston Company, Grand Rapids, Mich., successor to the Grand Rapids Grinding Machine Company. The grinder is driven by a self-contained motor, enabling it to be placed in any position in the shop toolroom where most convenient.

In the basic principles of design and operation it conforms to other Grand Rapids twist drill grinders. It has a diamond truing device and the diamond is furnished as part of the standard equipment for dressing the wheel. The holder is automatically placed in the right relationship with the grinding wheel so that it is close enough to grind the drills accurately and at the same time, the stop makes it impossible to bump the front of the holder into the grinding wheel. The machine illustrated is the A-7-T type with a capacity for drills from No. 52 to ¾-in. It is also made with a drill holder having a capacity of from ⅛-in. to 1½-in. drills, in which case it is designated style B-7-T.

Device to Prevent Loss of Grease Plugs

AN attachment to prevent the loss of grease plugs and bushings has recently been patented by Frank L. Fisher, Milwaukee, Wis. The principal part of the device is a spring placed so that when the grease plug is screwed into the side rod it comes in contact with a flat surface on the side of the plug. This spring prevents any vibration between the plug and the threads of the side rod bushing, which are locked together. As seen in the illustration, the spring is expanded by the insertion of the plug, against the inside threads of the side rod, causing a binding action between the rod and the bushing. This prevents the bushings from rattling out.

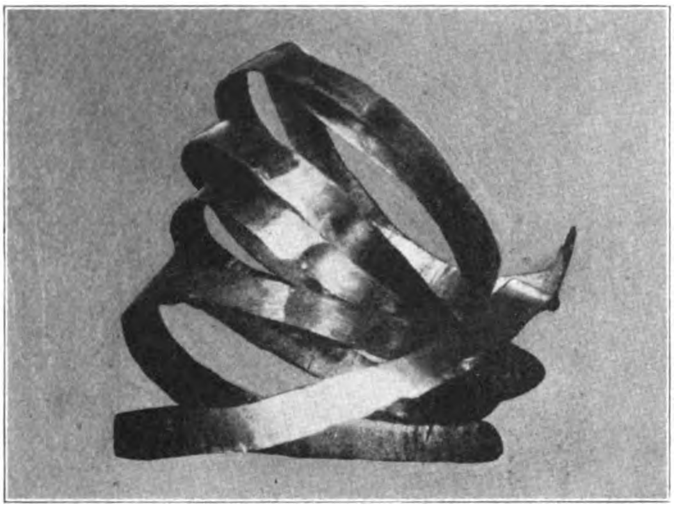
The spring is made of .036-in. by 5/16-in. spring steel. It is adaptable to different size grease plugs, as it is not essential that the diameter of 2 in. be maintained. The inventor states that the cost of the device should be from one to two cents, as the plug and bushing will be cast so as to permit the use of this attachment. Such being the case, this type of grease plug should cost approximately the same as an ordinary grease plug casting.



Sectional View of Grease Plug With Spring Attachment

Long Air Hammer Chip

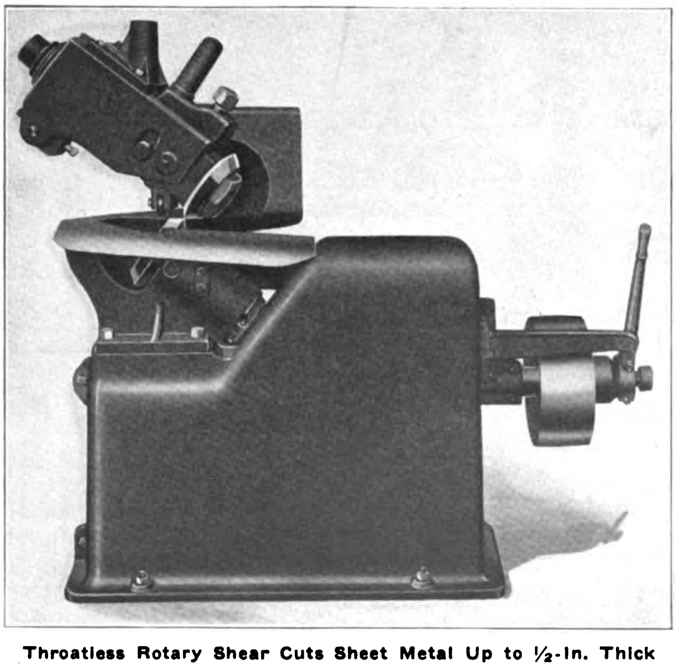
An unusual example of air hammer cutting power and smoothnes of operation is afforded by the long steel chip illustrated. This chip is 1/16 in. thick and 112 in. long, having been cut from a locomotive firebox side sheet by a No. C Thor chipping hammer with 3-in. stroke, made by the Independent Pneumatic Tool Company, Chicago. The air hammer in question had been in practically constant service for four years, and this long chip therefore shows both the durability of the hammer and the uniform strokes and accurate hammer control, without which boiler-makers cannot do a good job in trimming firebox sheets.



Air Hammer Chip 112 Inches Long, Cut from Locomotive Firebox Side Sheet By Thor Chipping Hammer

Rotary Type Sheet Metal Shear

A shearing machine of the rotary type, known as the Throatless Shear, has been placed on the market by the Marshalltown Manufacturing Company, Marshalltown, Iowa. This machine, built in a number of sizes, cuts tin and sheet metal up to ½ in. thick, but its particular feature, as may be inferred from the name, is ability to cut sheets of any size, no matter how large. The machine is adapted for cutting in and out curves and complete circles, also for straight splitting. Circles as small as 20 in. in diameter can be cut.



Throatless Rotary Shear Cuts Sheet Metal Up to ½-In. Thick

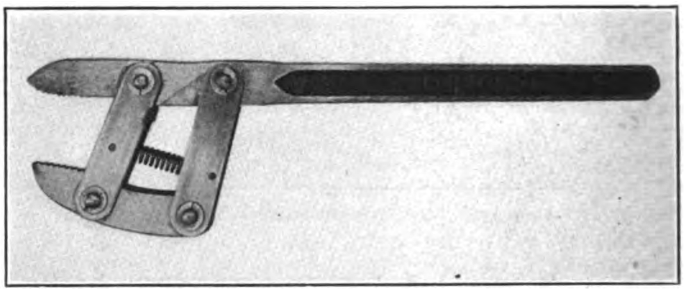
The head of the machine as well as most of the parts are made of cast steel. They are strongly built, designed with a large factor of safety, and it is said that not one has ever sprung or broken in operation. The cutters are set almost perpendicular, and are made of special tool steel 1⅛ in. thick and 10 in. in diameter, tempered. One of the cutters is knurled and driven which makes the shear self feeding.

The machine can be provided with either belt or motor drive, in the former case a friction clutch pulley being furnished as illustrated. With motor drive a friction clutch gear enables the operator to stop the shear with the motor still running. The speed of the pulley is 270 r. p. m., and sheets are cut at the rate of 6 ft. per min. The floor space required for the machine is 2 ft. 8 in. by 4 ft. 2 in., the distance from the floor to the cutters is 42 in. When motor driven, a 5-hp. motor running at 1,750 r. p. m. is required. The net weight is 4,600 lb.

This machine is adapted for use in locomotive boiler shops and tin shops, but should prove especially valuable in steel car shops where large and often irregular-shaped sheets have to be cut to replace those which are worn out in service or damaged in wrecks.

Self-Adjusting Wrench

A new wrench, known as the "Roberts" type, which does away with the usual hand screwing adjustment to make it fit an object, has been put on the market by the Greater Service Electric Company, Newark, N. J. Using only one hand with the wrench, it is simply necessary to place it over the object and it grips instantly. The wrench is said never to slip—the harder it is pulled the stronger it grips, and at any angle. It also works with a new ratchet action which makes it easy to use in tight places.



New Wrench with Quick Adjustment Feature

The wrench is drop forged from high speed carbon steel. In its present 12-in. size, this wrench will handle any shape article from small nuts to one-in. pipe.

The Chicago, Rock Island & Pacific has put into effect a plan whereby an employee entering the mechanical forces will be given personal instruction concerning his duties and the work which he will do. Under the plan each new apprentice entering the shop forces is examined to determine his special qualifications for certain work and is given instruction by a mechanic until he learns the general principles. This instruction is followed by technical training for special work to which he is finally assigned. Classes are now being conducted at Silvis, Ill., and similar classes are being organized at other points. The instruction is designed to develop a higher grade of mechanic and to remove the difficulty which now exists when an employee is placed in a position and left to work out his own salvation without proper instruction.

GENERAL NEWS

It is reported that the turbo-condensing locomotive invented by M. Ljungstrom is now running on regular express traffic between Stockholm and Hallsberg.

It is reported that a number of engineers of the Canadian National Railways are going to Europe to investigate the operating conditions under which Diesel oil-burning locomotives are used there.

According to George McCormick, general superintendent of motive power of the Southern Pacific, a number of Atlantic type locomotives have been equipped with boosters, feedwater heaters and other efficiency and economic appliances, at the Sacramento general shops. One of these locomotives was No. 3025. This engine was used at the exposition in San Francisco in 1915 to supply steam for the colored lighting effects. These newly equipped locomotives are making through runs of 471 miles. In test runs it was shown that they can travel from Los Angeles to San Luis Obispo, Cal., on a single tank of water, making intermediate stops unnecessary. The increased power permits smooth starting in trains from stations without the necessity of having to take up the slack in the train.

Anthracite Shipments in November

Shipments of anthracite for the month of November, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 5,828,754 gross tons, as compared with 6,564,526 gross tons in October, a decrease of 735,772 tons, or 11 per cent. The average daily shipment for the time the collieries were in operation during the month of November exceeded that for the month of October. Comparing November shipments of this year with the corresponding month in 1921, the latest normal year, an increase of 514,740 tons is shown, or 9.7 per cent.

New Directors for the A. R. A.

Directors of the American Railway Association for the term ending in November, 1926, have been elected as follows: Canadian Territory, Sir Henry W. Thornton, Canadian National; Eastern Territory, W. W. Atterbury, Pennsylvania, and E. E. Loomis, Lehigh Valley; New England Territory, E. J. Pearson, N. Y., N. H. & H.; Southern Territory, N. D. Maher, Norfolk & Western; Western Territory, Hale Holden, C. B. & Q., and W. B. Storey, A. T. & S. F. Messrs. Samuel Rea, Ralph Budd and C. E. Schaff were elected members of the committee on nominations for the term expiring in November, 1925.

Big Shop Improvement Program Carried Forward by Denver & Rio Grande Western

During the course of the year the Denver & Rio Grande Western has carried forward a large shop improvement program involving approximately $3,000,000. Improvements were made to shops at various points on the system, the location, estimated total expenditures and per cent completed estimated up to the end of the year being as follows: Burnham, Colo., $886,000, 28 per cent completed; Salida, Colo., $342,000, 65 per cent completed; Grand Junction, Colo., $242,000, 70 per cent completed; Alamosa, Colo., $158,400, 75 per cent completed and Salt Lake, Utah, $1,167,000, 35 per cent completed.

Locomotive Development Shown in Great Northern Exhibit

Two locomotives, which illustrate graphically the developments in motive power which have been made during the last half century, are being sent over the line of the Great Northern for exhibition purposes at various points. They are the "William Crooks No. 1," which was the first engine brought into the state of Minnesota and which arrived on a river barge in 1861, and passenger locomotive No. 2500, which represents the latest type for passenger service. In connection with the exhibition, the Great Northern is offering a prize of $10 for the best amateur photograph of the two engines. More than 500 snapshots were taken at Grand Forks, N. D., Devils Lake and Minot, the points which have already been visited.

Wage Statistics for September

The Interstate Commerce Commission's summary of the reports of Class I steam roads for September indicates that this is the first month, since January, 1923, in which the employment has failed to show an increase over the returns for the preceding month. The carriers reported 1,945,917 employees, a decrease of 27,588 or 1.4 per cent as compared with the number reported for August, 1923, and an increase of 237,326 or 13.9 per cent over the returns for September, 1922. This large increase in employment is due partly to the increased business of the year 1923 and partly to the fact that in September of last year the shopmen's strike was still effective on many roads. In the transportation (train and engine service) group the employment was greater in September, 1923, than in any month reported under the present classification of employees, which became effective July 1, 1921.

November Locomotive Shipments

The Department of Commerce has prepared the following table showing November shipments of locomotives from the principal manufacturing plants, based on reports received from the individual establishments:

	Nov. 1923	Oct. 1923	Nov. 1922	Eleven months' total Jan. to Nov. 1923	Eleven months' total Jan. to Nov. 1922
Shipments:					
Domestic	270	295	144	2,680	862
Foreign	29	15	15	180	202
Total	299	310	159	2,860	1,064
Unfilled orders (end of month)					
Domestic	656	915	1,501	....	....
Foreign	35	62	118	....	....
Total	691	977	1,619	....	....

Labor Board Decisions

C. & A. Ordered to Negotiate with A. F. of L. Unions.—The Shop Employees' Association of the Chicago & Alton, which was formed by the shop workers subsequent to the shopmen's strike in 1922, has been ruled out by the Labor Board as the authorized representative of the shopmen on the road, and the Chicago & Alton has been ordered to negotiate changes in the shopcrafts agreement now in effect with the committee of the shop employees represented by System Federation No. 29 of the Railway Employees' Department, American Federation of Labor. Of the 2,700 mechanical department employees in the service of the Alton there are approximately 15 now in service who participated in the formation of the association last year, according to testimony. In its decision, the board ordered that, if a question arises relative to the right of the Federated Shop Crafts to represent the shop employees on the Alton, arrangements shall be made to take a secret ballot to determine the wishes of such employees definitely. —*Decision No.* 2024.

Election of Employee Representatives Under Labor Board Orders.—In two addenda to previous decisions, the Railroad Labor Board has ordered that in case one or more of the interested parties in an election of employee representatives ordered by the board should decline to participate therein, the employees are nevertheless entitled to an election. In one instance, the Gulf Coast Lines

and the Houston Belt & Terminal refused to participate in an election ordered by the board in Decision No. 1838 on petition of the Railway Employees' Department of the American Federation of Labor. The Great Northern also declined to participate in an election ordered by Decision No. 1947, also on petition of the Railway Employees' Department of the American Federation of Labor. In both instances, the board has ordered that if the representatives of the road decline to assist in holding the election, the representatives of the employees who desire to participate in the election shall arrange the details of the ballot, giving due notice to any other organizations comprising employees of this class of the date of election and taking other precautions for a fair election.—*Addendum No.* 1 *to Decision No.* 1838 *and Addendum No.* 1 *to Decision No.* 1947.

Court Decisions

CONSTRUCTION OF BOILER SAFETY APPLIANCE ACT.—In a fireman's action for injuries from a fall caused by the shaker bar slipping off the lever, the Texas Court of Civil Appeals holds that under the Boiler Safety Appliance Act the railway company is under the absolute duty to keep the shaker bar in proper condition and safe to operate, so that it may be used by the employee without unnecessary peril to life or limb. No rule has been promulgated by the Interstate Commerce Commission as to how tight the shaker bar must fit over the end of the lever attached to the grates, so that the railroad must exercise its common-law duty in selecting the appliance.—Davis v. Callen (Tex. Civ. App.), 250 S. W. 305.

DEDUCTION FROM WAGES FOR ABSENCE ON ELECTION DAY.—The Illinois Supreme Court holds that the act of June 22, 1891, Section 25, as amended (Hurd's Rev. St. 1917, C. 46, Section 312), in so far as it forbids the employer to make deduction from an employee's wages because of his absence for two hours on election day for voting, deprives employers of their money and property without due process of law, and denies them the equal protection of the laws in violation of the state and federal constitutions, and is not a valid exercise of the police power as tending to promote the health, safety or morals of employees, or the public comfort, welfare, safety, or morals.—People v. Chicago, M. & St. P., 206 Ill. 486, 138 N. E. 155.

FEDERAL ASH PAN ACT.—The Texas Court of Civil Appeals hold that in the requirement in the federal Ash Pan Act of ash pans which can be dumped or cleaned without the necessity of the employee going under the locomotive, the words "go under" are to be used in their popular sense, and a violation is not proved by showing that in closing the pan the employee's body would be partially under the running board or the extension of the floor of the cab. Otherwise appliances would be required extending several feet beyond the rails, rendering them dangerous.—Fort Worth & D. C. v. Smithers (Tex. Civ. App.), 249 S. W. 286.

Movement Started to Co-ordinate Study of Fuel Economy by the Railroads

Co-operative action on the part of all the railways looking toward a reduction in the annual fuel bill was anticipated at a joint meeting of the American Railway Association's Committee on Fuel Conservation, of which F. H. Hammill, assistant general manager, Chicago & North Western, is chairman, and a committee of the International Railway Fuel Association, of which Eugene McAuliffe, special representative, Union Pacific, is the chairman.

The most important action taken at this meeting, which was held at Chicago on December 19, related to the establishment of some central agency for consolidating a large part of the test work and fuel research relating to fuel economy that is now being individually undertaken by railways throughout the country. The plan recommended for adoption by the executives of the American Railway Association would provide for the employment of a research director with necessary staff for the consideration of problems relating to railway fuel operating economies. The plan contemplates an immediate canvass of the present facilities and the measure of co-operation that may be obtained from the various existing laboratories now equipped and in position to carry on research work. It would also provide for the dissemination of the available information pertaining to fuel and related operating economies as developed in tests heretofore made by individual railways and educational institutions.

The railways have already achieved remarkable economies in fuel use as a result of the tests conducted by many railroads during recent years, but there is yet a vast amount of research work to be accomplished toward the attainment of maximum fuel economy. The several locomotive testing plants now available to the railways cannot be fully utilized until some such co-operative plan as now proposed is put into effect. The continuous use of one or more locomotive testing plants under these conditions would not only afford more authoritative information as to the value of certain devices and practices in relation to fuel economy than is now obtainable, but would obviate a large duplication of effort on the part of various railways that are now separately engaged in an investigation of the same devices and methods.

The Interstate Commerce Commission does not now require the railways to use a uniform ratio in equating the quantities of fuel oil and coal burned as reported in the monthly operating statistics for Class I railways, so that at the present time there are wide variations in these reports to be accounted for. At the meeting on December 19 consideration was given to the steps that have already been taken by the International Railway Fuel Association and the American Railway Association's committee on Fuel Conservation toward the determination of a satisfactory ratio for this purpose and the presentation of this matter before the Bureau of Statistics of the Interstate Commerce Commission with the recommendation that this ratio be made compulsory for all railways reporting quantities of oil consumed in terms of pounds of coal.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL. V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 W. Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting January 8. A paper on Some Recent Notable Locomotives, also some performance figures on three-cylinder locomotives, will be presented by James Partington, estimating engineer, American Locomotive Company.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 605 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting January 8. Paper on Stores and Supplies will be presented by U. K. Hall, general storekeeper, Union Pacific.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting January 11. A paper on Locomotives will be presented by Grafton Greenough, Baldwin Locomotive Works.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Bucyrus Company, South Milwaukee, Wis., is preparing plans for an addition to its plant at Evansville, Ind.

The Orton & Steinbrenner Company, Chicago, has completed an addition to its works at Huntington, Ind., which will double the output of the company.

Dwight E. Robinson has been appointed manager of railway sales department for Toch Brothers, Inc., 110 East Forty-second street, New York City.

The Bethlehem Shipbuilding Corp., Ltd., Union plant has removed its city sales offices to 1000 Matson building, 215 Market street, San Francisco, Cal.

J. G. Aye, general foreman of the Southern Pacific at Fresno, Cal., has been appointed a service engineer of the Franklin Railway Supply Company, Inc., New York.

The O'Fallon Railroad Supply Company, St. Louis, Mo., has been appointed representative in the southwestern territory for the Burden Iron Company Railroad and Steamship Division, St. Louis.

Willard A. Smith, editor and publisher of the Railway Review, Chicago, died at Evanston, Ill., on November 29, at the age of 74, failing by only a few months to complete a half-century as publisher of that paper.

N. P. Farrar has been appointed district manager of the Pawling & Harnischfeger Company, Milwaukee, Wis. Mr. Farrar's headquarters are at 605 Stephen-Girard building, Philadelphia, Pa., and 50 Church street, New York City.

John D. Ristine, sales manager of the railroad motor coach division of the Service Motor Company, with headquarters at Wabash, Ind., has resigned to become assistant vice-president of the Mason Coal Company, with headquarters at Chicago.

D. B. Wright has resigned as railroad representative with Paul Dickinson, Inc., with headquarters in Chicago, to become manager of the railroad sales department of the B. F. Nelson Manufacturing Company, Minneapolis, Minn., manufacturers of roofing, insulating and waterproofing materials.

The Q & C Company, New York, announces that it has acquired the exclusive United States rights for the manufacture and sale of the Unlimited travel type roller side bearing, under any and all patents granted to E. A. Laughlin, Oregon, Ill., and previously sold by the Standard Coupler Company.

Hendricks Commercial Register, New York, heretofore owned by the Kelly Publishing Company of London, England, will be taken over on January 1, 1924, by MacRae's Blue Book Company, Chicago. Both books will continue as at present.

The H. B. Wilson Company, St. Louis, Mo., composed of H. B. Wilson and J. M. Shea, who have represented the Mahr Manufacturing Company in that city for the last two years, has recently been given additional territory extending along lines of various railroads out of St. Louis and including Kansas City.

J. R. Sexton, railway sales manager of the H. H. Robertson Company, with headquarters at Chicago, has also been appointed district manager, with the same headquarters, succeeding H. F. Hackedorn, deceased. Mr. Sexton will continue as manager of railway sales in conjunction with his work as district manager.

LeGrand Parish, who has been president of the Lima Locomotive Works, Inc., since 1918, has resigned to devote his entire attention to the American Arch Company, Inc., of which he is also president. He will, however, remain on the executive committee of the former company. J. S. Coffin has been elected president of the Lima Locomotive Works to succeed Mr. Parish.

The Pfaudler Company, Rochester, N. Y., makers of glass-lined steel milk tank cars, has appointed H. A. Stuart, manager of the newly created milk transportation division, with headquarters at Rochester, N. Y. This company has inaugurated a system of leasing so that the dairyman is not obliged to purchase the glass-lined milk tank car used in transporting milk in bulk, but may lease it for a period of time at a fixed rental, and at the end of this period either purchase the car outright or renew the lease.

The National Malleable Castings Company, Cleveland, Ohio, will change its corporate name in the near future to the National Malleable & Steel Castings Company. The corporation now has shops in operation at Cleveland, Ohio; Sharon, Pa.; Toledo, Ohio; Indianapolis, Ind.; East St. Louis, Ill.; Chicago, and Melrose Park, near Chicago. There will be no change in the officers or personnel of the corporation and the change in name is to be made to cover the scope of its steel castings production.

The Stewart Manufacturing Corporation, Chicago, has taken over the properties of the Jerome-Edwards Metallic Packing Company, Chicago, and George C. Jerome, president of the Jerome-Edwards Metallic Packing Company, has been appointed manager of the railroad department of the Stewart Manufacturing Company, with headquarters at Chicago. He was born on November 10, 1865, at Port Huron, Mich., and entered the metallic packing business in 1884 with the C. C. Jerome Company, which was organized by his father. He held numerous positions in the plant and was traveling representative for the company when he took over the control of the business. In 1903 he organized the Jerome & Elliott Company at Chicago and in 1913 purchased the interest of Mr. Elliott and organized the Jerome-Edwards Metallic Packing Company at Chicago.

G. C. Jerome

James H. Waterbury, for twelve years resident manager of Pratt & Lambert, Inc., Buffalo, N. Y., died on December 8, at the Buffalo General Hospital, following a brief illness. Mr. Waterbury was born in Brooklyn, N. Y., on January 1, 1881. After completing school in his native city, he attended a private school near Philadelphia, Pa. He began his business career in the New York office of Pratt & Lambert, Inc., in January, 1898. Two years later he went to Buffalo as assistant resident manager and since 1911 served as resident manager.

A. E. Ostrander, formerly in charge of engineering for the American Car & Foundry Company, who has been on a leave of absence since early in 1922, has returned to work and on December 17 was transferred to the sales organization with the title of assistant vice-president and with headquarters at New York City. Mr. Ostrander is in charge of the miscellaneous sales department and will also handle special sales duties as may be assigned. He was born in New Haven, Conn., and began his career with the New York, New Haven & Hartford, serving in various capacities in the operating and mechanical departments of that road. He later entered the service of Cornelius Vanderbilt in New York City, and from there went with the mechanical department of the Standard Steel Car Company at Pittsburgh. In 1903 he came to the New York office of the American Car & Foundry Company, serving successively as draftsman, estimator, chief estimator and assistant mechanical engineer. In 1915 he was appointed mechanical engineer and in 1918 general mechanical engineer, with headquarters in New York.

A. E. Ostrander

The Compagnie Belgo-Mandchoue de Commerce, 39 Kitaiskaja, Harbin, Manchuria, is a large contractor for the Chinese Eastern Railway, and buys various materials for the road. It wants the names of American firms that can supply the following: Spare parts for railway cars and locomotives; tools for use on railways, hand tools for metal working, also wood working tools, and other miscellaneous tools; shovels; axes; iron pipes; copper pipes; valve cocks; pumps; bolts, nuts, etc.; merchant iron, sheet iron, corrugated iron; tool steel; builders' hardware, wire nails, also iron nails; electrical appliances; paints and varnish; railway scales and railway supplies, also a number of other products.

The Cincinnati-Bickford Tool Company, Cincinnati, Ohio, with the beginning of the New Year, announces the commencement of the second half century of its business life. This company was incorporated on January 2, 1874, and since that time has been continuously engaged in the manufacture of drilling machinery. At the beginning of its history, it employed a working force of ten men. This has increased to 550 at the present time. It has in turn occupied four shops, each one larger than its predecessor, before the present plant was built in 1909. This is said to be the largest plant in the world devoted exclusively to building metal drilling machinery. Engraved announcements of its semi-centennial anniversary have been issued by August H. Tuechter, president of the company.

L. G. Plant has been appointed assistant to the president of the National Boiler Washing Company, Railway Exchange building, Chicago. Mr. Plant was born at Minneapolis, Minn., in 1885 and was first employed by the Baldwin Locomotive Works as a special apprentice and as a boilermaker apprentice on the Southern Railway. He studied at the University of Virginia and at Stevens Institute of Technology from which he received the degree of mechanical engineer in 1909. He then entered the employ of the Southern Pacific lines as a student of operation. Later he was employed as a mechanical engineer on a subsidiary of the Southern Pacific in charge of equipping the railroad for the use of fuel oil, and in 1913 was appointed superintendent of fuel service for the Southern Pacific Lines in Texas and Louisiana. In 1914 he was appointed fuel engineer on the Seaboard Air Line, which position he held until 1918. Shortly after the Division of Finance and Purchases of the Railroad Administration was organized at Washington, he was made progress engineer and chief clerk to the manager of the procurement section. In March, 1920, Mr. Plant joined the staff of the *Railway Mechanical Engineer* as an associate editor and a year later he went to the Railway Review in the same capacity. On December 30, 1922, he was appointed to the position of editor of the Railway Review. Mr. Plant has given particular attention to locomotive fuel and terminal problems and is the author of a number of articles and papers on these and other subjects.

L. G. Plant

Joseph F. Farrell, general manager of the Nathan Manufacturing Company for the past seven years, has been appointed vice-president; Alfred Nathan, Jr., secretary, has been elected treasurer, and Edwin F. Wallace has been elected secretary, all with headquarters at New York. Mr. Farrell entered railroad service in December, 1889, as a clerk on the Lake Shore & Michigan Southern. In September, 1906, he became chief clerk in the purchasing department of the Lake Erie & Western. In April, 1907, he was appointed assistant purchasing agent of the Michigan Central, and in September, 1907, became purchasing agent of that railroad. Mr. Farrell left the railroad field in July, 1912, to become vice-president of the American Materials Company, and in August, 1916, was appointed general manager of the Nathan Manufacturing Company.

Stephen C. Mason, secretary and director of the McConway & Torley Company, Pittsburgh, Pa., who served as president of the National Association of Manufacturers from 1918 to 1921, died on December 12 at his home in Pittsburgh from dilation of the heart. He had been ill for about six weeks. Mr. Mason was born in Fairlee, Vt., on February 1, 1861, and was educated in the common school and at Orford (N. H.) Academy and Newbury (Vt.) Seminary. He began his business career with the Connecticut & Passumpsic Railroad at Lyndeville, Vt., in 1880, serving with that company until 1888, when he resigned to go with the Interstate Commerce Commission at Washington, with which he served in various capacities until as assistant statistician he was in charge of the compilation and publication of the commission's statistics of railways in the United States. He gave up this position in 1896 to go to the McConway & Torley Company, where he served in various capacities and at the time of his death was secretary and director of that company. He was vice-president from Pennsylvania of the National Association of Manufacturers and then became president. He was also vice-president of the Steel Founders' Society of America, executive member of the Railway Business Association, also a member of the National Industrial Conference Board, member of the Chamber of Commerce of Pittsburgh and chairman of the finance committee of the Railway Club of Pittsburgh.

S. C. Mason

Frank C. Pickard has been elected vice-president of the Talmage Manufacturing Company, Cleveland, Ohio. Mr. Pickard was born on September 20, 1880, at Trenton, Mich., and entered railroad service as a messenger boy at the age of 14 on the Chicago, Hammond & Western at Hammond, Ind. At Bedford, Ind., on the Southern Indiana, he finished two years' apprenticeship at the machinist trade and entered the road service as a fireman and engineman. After leaving that service, he worked on various western railroads until 1905, when he entered the service of the Pere Marquette as a machinist and served as machine foreman, erecting foreman and shop superintendent. In 1908 he left the Pere Marquette to go as master mechanic on the Mississippi Central and in 1909 went to the Cincinnati, Hamilton & Dayton as master mechanic of the Indianapolis and Springfield division. During this period he was elected president of the International Railway General Foremen's Association and served for two terms. In 1911 Mr. Pickard was appointed master mechanic of the Saginaw district of the Pere Marquette and in 1912 entered the service of the Delaware, Lackawanna & Western as division master mechanic at Buffalo, N. Y. He was a contributor to railroad clubs and technical journals on mechanical subjects. During this time he served as president of the Central Railway Club and as a member of the executive committee of the Niagara Frontier Car Inspection Association. He resigned from the Delaware, Lackawanna & Western on December 1 to enter his present connection.

F. C. Pickard

TRADE PUBLICATIONS

Air Hoists.—Hanna patented air hoists and I-beam trolleys are fully described and illustrated in catalog No. 14, recently issued by the Hanna Engineering Works, Chicago.

Electric Motors.—"Electric Motors—How to Choose and Use Them," is the title of an interesting 32-page brochure recently issued by the Reliance Electric & Engineering Company, Cleveland, Ohio.

Threading Machines.—The Geometric Tool Company, New Haven, Conn., has issued a 38-page illustrated brochure describing its Geometric threading machines, which are built in ½ in., ¾ in. and 1½ in. sizes.

Cranes.—Two new booklets, Nos. N-1346 and N-1387 (O-2057), illustrating and describing power house and other bucket handling cranes have been issued by the Whiting Corporation, Harvey, Ill.

Brass Goods.—Hose couplings, nozzles, clamps, valves, sill cocks and other brass accessories are described and illustrated in a neatly arranged catalogue recently issued by the Schlangen Brothers Company, Chicago.

Engine Tender Connections.—Bulletin No. 42, containing interesting statistics and test data, has recently been issued by the Barco Manufacturing Company, Chicago, describing its 3V type engine tender connections for steam, air, oil and water.

Wrought Pipe.—Seven reports covering unusual accidents, which show the great strength, uniformity and durability of National pipe, are contained in a booklet entitled, "Seven Wonders of Wrought Pipe," recently issued by the National Pipe Company, Pittsburgh, Pa.

Insulation.—A 63-page illustrated booklet covering the subject of insulation of high temperature apparatus, such as is used by almost all industries—steam lines and equipment, ovens, furnaces, stills, cookers, kettles, sterilizers, etc.—and describing the peculiar qualities of Nonpareil high pressure covering, blocks and cement for high temperature insulation, has recently been issued by the Armstrong Cork & Insulation Company, Pittsburgh, Pa.

Micarta.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a 24-page illustrated booklet entitled, "A Material of Endless Possibilities," containing information about Micarta and the many uses to which it has been put and indicating the possibilities for other applications. Some of the products for which Micarta is already used are bushings, gears, gaskets, handles, insulators, pinions, pulleys, washers, etc.

Stokers.—The Westinghouse new model multiple retort underfeed stoker is described and fully illustrated in a 14-page brochure recently issued by the Westinghouse Electric & Manufacturing Company, Philadelphia, Pa. It shows the results they have obtained in this line after thirty-five years' experience in the design and manufacture of combustion equipment. The stoker is built in all types and sizes to meet the specifications for industrial and central station requirements.

Gears and Speed Transformers.—William Ganschow, president of the William Ganschow Company, Chicago, is editing a new handbook on gears and speed transformers, which will be combined with the forthcoming Ganschow general catalog No. 100. The purpose of the handbook is to afford the user of gears and speed transformers easy access to formulæ and data regarding their design and use. It contains much data that is usually found only in general engineering handbooks. Aside from the formulæ and data pertinent to gears and speed transformers, it also contains much information that is useful in the designing of machinery to which they may be applied. There are also tables showing strength and weight of materials, trigonometric functions, geometric formulæ, decimal equivalents, wire and sheet metal gages, and standard screw threads, together with other miscellaneous information. Being combined with the general Ganschow catalog, it brings together in one volume all the information necessary for the design or specifications of gears or gearing for any purpose, and shows complete lists for all products, which are regularly manufactured by the Ganschow Company.

EQUIPMENT AND SHOPS

Locomotive Orders

The Texas-Mexican has ordered from the Baldwin Locomotive Works a 4-6-0 type locomotive.

The Mobile & Ohio has ordered two 4-6-2 type locomotives from the Baldwin Locomotive Works.

The Alabama & Vicksburg has ordered three 4-6-2 type locomotives from the Baldwin Locomotive Works.

The San Joaquin & Eastern has ordered one Prairie type locomotive from the Baldwin Locomotive Works.

The Argentine State Railway has ordered five 2-8-2 type locomotives from the Baldwin Locomotive Works.

The Toledo, Angola & Western has ordered one 2-8-2 type locomotive from the American Locomotive Company.

The South Manchurian Railway has ordered five 2-8-2 type locomotives from the American Locomotive Company.

The Delaware, Lackawanna & Western has ordered 10 2-8-2 type, 10 4-6-2 type and 5 4-8-2 type locomotives from the American Locomotive Company. The 2-8-2 type will have 28 by 32 in. cylinders and a total weight in working order of 357,000 lb.; the 4-6-2 type will have 25 by 28 in. cylinders and a total weight in working order of 297,000 lb.; the 4-8-2 type will have 28 by 30 in. cylinders and a total weight in working order of 370,000 lb.

Freight Car Orders

The Chesapeake & Ohio will build 25 caboose cars in its own shops.

The Philadelphia & Reading will build 20 caboose cars in its own shops.

The Chicago & Alton has ordered 250 box cars from the Pullman Company.

The Seaboard Air Line has ordered 25 caboose cars from the Magor Car Corporation.

The Louisville, Henderson & St. Louis has ordered 3 baggage and mail cars, 2 coaches and 2 smoking cars from the American Car & Foundry Company.

The Gulf Coast Lines has ordered 4 coaches, 2 partition coaches, 2 baggage and 2 baggage and mail cars from the American Car & Foundry Company.

The Baltimore & Ohio has ordered 500 hopper cars from the Pressed Steel Car Company and 500 box cars from the American Car & Foundry Company, the railroad reserving the right to furnish some of the trucks.

The Pacific Fruit Express Company is placing orders for the building of 3,057 new refrigerator cars for delivery prior to the peak of the 1924 season. It is estimated the cost of the new cars will be about $10,000,000.

The Alabama & Vicksburg has ordered 100 gondola cars of 50 tons' capacity from the American Car & Foundry Company, and 200 box cars of 40 tons' capacity and 100 flat cars of 50 tons' capacity from the Chickasaw Shipbuilding Company.

The Southern Railway, reported in the December *Railway Mechanical Engineer* as having ordered 1,000 box cars from the American Car & Foundry Company, has increased the order 2,000 cars, making a total of 3,000 cars ordered from the American Car & Foundry Company.

Machinery and Tools

The Chicago, Burlington & Quincy has placed an order for 2 car wheel borers.

The New York, New Haven & Hartford has placed an order for a car wheel borer.

The Denver & Rio Grande Western has ordered a 90-in. wheel quartering machine.

The New York Central has placed an order for a 14-in. engine lathe and for a 42-in. journal lathe.

The Northwestern Pacific has ordered a 15-ton electric traveling crane from the Whiting Corporation.

The Pere Marquette has ordered eight jib cranes of from one to six tons' capacity from the Whiting Corporation.

The Wabash has ordered one 22-ton 8-wheel standard gage locomotive crane from the Orton & Steinbrenner Company, Chicago.

Shops and Terminals

Wabash.—This company plans the construction of a 20-stall brick roundhouse at St. Thomas, Ont.

Kansas City Southern.—This company will construct a two-story office building at its shops at Pittsburg, Kan.

New York, Chicago & St. Louis.—This company will construct a one-story machine shop at Conneaut, Ohio, at a cost of $40,000.

Central of Georgia.—This company plans the reconstruction of a portion of its car shops at Savannah, Ga., recently destroyed by fire with a loss reported to be $500,000.

Southern.—This company has authorized Dwight P. Robinson & Company, Inc., to design and construct extensive additions to its shops at Birmingham, Ala. The work includes locomotive repair shops, boiler and smith shop, car repair sheds, mill shop, power plant and other buildings.

Chesapeake & Ohio.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of water treating plants at Moorehead, Ky., Olive Hill, Hurricane, W. Va., and Sproul. The company also plans the construction of a roundhouse and machine shop at Ironton, Ohio.

Galveston, Harrisburg & San Antonio-Southern Pacific.—This company will construct an addition to its engine terminal at San Antonio, Tex., with the company forces at a cost of $80,000, including boiler washing plant and enlargement of roundhouse by the construction of three additional engine stalls and the extension of the existing six stalls, 47 ft.

Atchison, Topeka & Santa Fe.—This company has authorized the construction in 1924 of the following units in expansion of the terminal facilities at San Bernardino, Cal.: A boiler shop with tank shop and stripping pit, 600 ft. by 160 ft., to cost $900,000, with mechanical equipment; extension of erecting bay of locomotive shop; installation of a new transfer table; extension of the present machine shop, 200 ft. by 196 ft. Of the appropriation of $2,800,000, $600,000 will be spent this year. A contract has been awarded to Joseph E. Nelson & Son, Chicago, for the construction of an apprentice school building at San Bernardino, Cal., to cost $30,000.

Baltimore & Ohio.—This company has awarded a contract to the American Water Softener Company, Philadelphia, for water softener equipment in treating plants at North Dayton, Ohio, Troy, Old River Junction, Lima, Deshler, Rosford and Fairmount, W. Va. The contract for the construction of buildings, tank foundations and the installation of piping and all machinery at Troy, Old River Junction, Lima, Deshler and Rosford has been awarded to Joseph E. Nelson & Sons Company, Chicago. Contracts have also been awarded to the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., for the construction of water treating plants at Tontogany, Ohio, Wapakoneta, Ohio, and Twin Creek, Ohio.

Illinois Central.—This company has prepared plans for the construction of additions to its shops and yards at Evansville, Ind., to cost approximately $1,000,000, and has awarded contracts to the Drumm Construction Company, Chicago, for the construction of a concrete pit and scale house at Harahan, La., and to the Howlett Construction Company for the construction of a 300-ton reinforced concrete coaling station at Gilman, Ill., and a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a water treating plant and pumping station at Powderly, Ky. The company also plans the construction of a locomotive shop, roundhouse and oil station at Sioux City, Iowa, to cost approximately $500,000.

PERSONAL MENTION

General

F. T. Quinlan has been appointed engineer of tests of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

C. L. Peterson has been appointed general supervisor of power stations of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

F. E. Ballda has been appointed assistant to the mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

H. P. Hass has been appointed office assistant to the mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

R. W. Hunt has been appointed fuel supervisor of the Atchison, Topeka & Santa Fe, Coast lines and the Grand Canyon Railway, with headquarters at Los Angeles, Cal.

W. B. Shelton, motive power inspector of the Altoona works of the Pennsylvania System, has been appointed motive power inspector of the Monongahela division, with headquarters at Uniontown, Pa.

Silas D. Zwight, whose appointment as general mechanical superintendent of the Northern Pacific with headquarters at St. Paul, Minn., was announced in the December issue of the *Railway Mechanical Engineer*, was born on May 23, 1867, at LaCrosse, Wis. He attended elementary school and business college and entered railway service in May, 1866, on the Chicago, Burlington & Quincy. In June, 1888, he entered the service of the Northern Pacific as a locomotive fireman on the Dakota division and has since remained continuously in the service of the Northern Pacific. He was later promoted successively to locomotive engineer, road foreman of engines, master mechanic, general master mechanic, assistant to the mechanical superintendent, mechanical superintendent and acting general mechanical superintendent, which position he held at the time of his recent promotion to general mechanical superintendent.

S. D. Zwight

E. Gelzer has been appointed mechanical engineer of the Chicago, Great Western, with headquarters at Oelwein, Iowa. Mr. Gelzer was born in London, England, and educated in the Berlin Polytechnic Institute, Berlin, Germany. He served his apprenticeship with the Borsig Locomotive Works and the Blackhead Locomotive Works, Berlin, and in 1915 entered the employ of the Bethlehem Steel Company as a designer of machinery. He then became a designer of locomotives and enginehouse equipment on the Pennsylvania and subsequently served as enginehouse foreman at Fort Wayne, Ind., and motive power inspector, North Western region. In 1921 he entered the employ of the Illinois Central as leading draftsman, locomotive department. During the war he was with the 13th Engineers in France and later attached to the Interallied Commission for the inspection of German material. Mr. Gelzer is a member of the American Society of Mechanical Engineers and the American Association of Engineers.

J. C. McCullough has been promoted to assistant to the general manager of the Central region of the Pennsylvania with headquarters at Pittsburgh, Pa., Mr. McCullough was born on August

31, 1865, at Deersville, Ohio. He entered railway service on September 9, 1881, as a shop laborer on the Pittsburgh, Cincinnati, Chicago & St. Louis, now a part of the Pennsylvania, at Dennison, Ohio. Two years later he was promoted to machinist's helper and in 1884 to locomotive fireman. From 1887 to 1898 he served as locomotive engineer and on April 1 of the latter year was promoted to assistant road foreman of engines. On January 1, 1901, he was promoted to road foreman of engines, a year later being promoted to trainmaster. On March 1, 1910, Mr. McCullough was promoted to division superintendent and on April 16, 1919, to general superintendent of the Eastern Ohio division of the Central region with headquarters at Pittsburgh, Pa. He was serving in this capacity at the time of his recent promotion to assistant to the general manager of the Central region.

WILLIAM L. BEAN has been promoted to assistant mechanical manager of the New York, New Haven & Hartford. Mr. Bean was born on January 3, 1878, and was graduated from the University of Minnesota in 1902, having completed the course in mechanical engineering. He immediately entered the service of the Northern Pacific as a special apprentice and served in that capacity until late in 1904. On January 1, 1905, he became a gang foreman for the Atchison, Topeka & Santa Fe. In 1906 he was promoted to locomotive inspector and in 1908 to machine shop foreman. The following year he became division foreman and a few months later motive power assistant. In 1911 he was appointed bonus supervisor and held that position until early in 1912. Mr. Bean was out of railroad service then until July, 1916, when he entered the service of the New York, New Haven & Hartford as an analyst in expenses and methods. In 1917 he was promoted to assistant to the chief mechanical superintendent and in 1918 to mechanical assistant, which position he held at the time of his recent promotion.

W. L. Bean

B. B. MILNER has been appointed mechanical engineer of the Missouri-Kansas-Texas with headquarters at Parsons, Kan. Mr. Milner was born on November 5, 1881, at Hartford, Kan. In 1899-1900 he worked in the Parsons shops of the Missouri-Kansas-Texas, and then entered Purdue University, from the mechanical engineering school of which institution he was graduated in 1904. Thereupon he entered the service of the Pennsylvania as a special apprentice at Altoona Works. He later worked in the test department and on special investigations. In 1908 he entered the office of the general manager at Philadelphia to engage in various betterment studies. In 1911 he was appointed assistant master mechanic of the company's subsidiary, the Philadelphia, Baltimore & Washington. In 1913 he was appointed special engineer on the staff of the senior vice-president of the New York Central. He was subsequently appointed engineer of motive power and during the regime of the Railroad Administration acted as chief mechanical engineer. At the termination of federal control he was appointed engineer of motive power and rolling stock. In 1920 he joined the staff of Sale & Frazer, Ltd., Tokyo, Japan, and later practiced in a private capacity as a consulting engineer in that city. Lately Mr. Milner has been practicing as a consulting engineer in New York.

B. B. Milner

P. L. GROVE has been promoted to general superintendent of the Michigan division of the Pennsylvania, with headquarters at Grand Rapids, Mich. Mr. Grove was born on October 3, 1878, at Altoona, Pa. He entered railway service on May 1, 1894, as a messenger in the Altoona shops of the Pennsylvania and two years later was promoted to machinist apprentice. In 1899, he was promoted to machinist on special assignments, being promoted to inspector at the Columbia shops of the Philadelphia division in February, 1902. Mr. Grove was promoted to foreman of the State Line shops of the Bedford division in October, 1904, and in July, 1905, was again promoted to assistant master mechanic of the Altoona machine shop. He was promoted to assistant engineer of motive power of the Northern division, with headquarters at Buffalo, N. Y., in September, 1910. In September, 1917, he was promoted to superintendent of the Delaware division of the Philadelphia, Baltimore & Washington with headquarters at Wilmington, Delaware, and in February, 1920, was transferred to the New York division, with headquarters at Jersey City, N. J., which position he was holding at the time of his recent promotion.

P. L. Grove

Master Mechanics and Road Foremen

C. C. HAMILTON has been appointed master mechanic of the Canton Railroad, Baltimore, Md.

G. W. CUYLER, master mechanic of the Chicago, Rock Island & Pacific at Herington, Kan., has been transferred to Horton, Kan.

SAMUEL RUSSELL has been appointed division master mechanic of the Boston & Albany, with headquarters at West Springfield, Mass.

W. E. SCOTT has been appointed assistant road foreman of engines of the Seaboard Air Line with headquarters at Hamlet, N. C.

J. U. HOWIE has been appointed assistant road foreman of engines of the Seaboard Air Line with headquarters at Howells, Ga.

A. E. MCMILLAN, master mechanic of the Baltimore & Ohio at Dayton, Ohio, has been appointed district master mechanic with headquarters at Wheeling, W. Va.

T. W. MCCARTLEY, master mechanic of the Chicago, Rock Island & Pacific at Horton, Kan., has been transferred to Cedar Rapids, Iowa, succeeding C. B. Daily, promoted.

T. C. O'BRIEN, general foreman of the Baltimore & Ohio at Lima, Ohio, has been promoted to master mechanic of the Toledo division, with headquarters at Dayton, Ohio.

Car Department

T. R. WILLIAMS has been appointed assistant to the master car builder of the Northern Pacific, with headquarters at St. Paul, Minn.

J. B. GILLUM has been appointed car foreman of the Baltimore & Ohio at Keyser, W. Va., succeeding O. G. Stanley who has been promoted.

D. L. WINKLEPLECK has been appointed assistant general car foreman, and A. E. Tufts and W. S. McClung, assistant car foremen of the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa.

Shop and Enginehouse

O. G. Stanley has been promoted to superintendent of shops of the Baltimore & Ohio, with headquarters at Keyser, W. Va.

J. R. Lancaster has been appointed superintendent of the Scranton, Pa., locomotive shops of the Delaware, Lackawanna & Western.

A. W. Miller, general locomotive foreman of the Washington shops of the Baltimore & Ohio, has been transferred as general foreman to Lima, Ohio.

Charles S. Taylor, master mechanic of the Atlantic Coast Line, with headquarters at Wilmington, N. C., has been appointed shop superintendent of the Emerson shops, with headquarters at Rocky Mount, N. C. Mr. Taylor was born on January 7, 1886, at Wilmington, N. C. He is a graduate of grammar school and of McGuire's, Richmond, Va. He entered the employ of the Atlantic Coast Line on August 26, 1902, as a machinist apprentice. From September 4, 1906, until June 1, 1909, he served as a machinist, on the latter date being promoted to roundhouse foreman, with headquarters at Rocky Mount. On October 1, 1909, he was transferred as foreman to Richmond, Va.; January 1, 1911, transferred to Florence, S. C., as roundhouse foreman; March 18, 1912, promoted to general foreman at Wilmington, and on January 1, 1918, promoted to master mechanic, as above noted.

Charles S. Taylor

F. G. Casler, acting assistant road foreman of engines, has been appointed road foreman of engines of the Grand Rapids division of the Pennsylvania System, succeeding E. C. Gordon.

E. A. Burchiel, assistant road foreman of engines of the Toledo division of the Pennsylvania System, has been appointed road foreman of engines of the Ft. Wayne division, succeeding O. E. Maxwell.

C. A. White, master mechanic of the Atlantic Coast Line, with headquarters at Waycross, Ga., has been appointed shop superintendent, with the same headquarters, succeeding F. P. Howell. Mr. White was born at Montgomery, Ala., March 12, 1887. From September, 1904, to November, 1908, he was a machinist apprentice on the Atlantic Coast Line, subsequently serving as a machinist on the Missouri-Pacific at Little Rock, Ark.; the Southern at Selma, Ala.; the Mobile & Ohio at Tuscaloosa, Ala.; the Atlantic Coast Line at Waycross; and the Central of Georgia at Columbus, Ga. In September, 1909, he returned to the Atlantic Coast Line, serving as a machinist at Montgomery until October, 1910, when he was promoted to erecting shop foreman. In July, 1914, he became day roundhouse foreman, and in February, 1920, was transferred to Charleston, S. C., as general foreman. In March, 1921, he was promoted to master mechanic, with headquarters at Waycross.

C. A. White

Obituary

William Forsyth, formerly superintendent of motive power of the Northern Pacific and later mechanical engineering editor of the Railway Age and associate editor of its successor, the Railway Age Gazette, died at Chestnut Hill, Pa., on December 3. Mr. Forsyth was born on July 2, 1852, at Northumberland, Pa., and attended the Polytechnic College of Pennsylvania at Philadelphia from 1868 to 1870. He entered railway service in the latter year as a machinist apprentice on the Philadelphia & Reading. In 1874 he was employed by the Altoona Iron Company at Altoona, Pa., and a year later he entered the test department of the Pennsylvania at Altoona. Mr. Forsyth remained on this work until 1881 when he was appointed assistant master mechanic of the Pittsburgh, Fort Wayne & Chicago, with headquarters at Fort Wayne, Ind. In 1882, he was appointed mechanical engineer of the Chicago, Burlington & Quincy with headquarters at Aurora, Ill., and in 1898 he was appointed superintendent of motive power of the Northern Pacific, with headquarters at St. Paul, Minn. In 1900, Mr. Forsyth was appointed mechanical engineer for the Pennsylvania Coal Company at Scranton, Pa., and a year later was appointed associate professor of locomotive and car design at Purdue University. He joined the staff of the *Railway Age* in 1903 and continued in this capacity until 1911, when he retired.

William Forsyth

J. H Setchel, formerly secretary and president of the American Railway Master Mechanics' Association and later sales manager of Jerome & Elliott, manufacturers of metallic packing, died on December 13 at Cuba, N. Y. He was born on December 25, 1835, at South Bainbridge, Chenango county, New York, and in early life entered railroad service with the Galena & Chicago Union Railroad in its roundhouse. Soon after, he served a two-year apprenticeship as machinist with the Detroit Novelty Works at Detroit, Mich., and for several years following was a machinist and locomotive engineer on the Ohio & Mississippi. Subsequently until the breaking out of the Civil War, he was a locomotive engineer on the Louisville & Nashville. During the first year of the war he was a foreman at Nashville, Tenn., and from 1862 to 1868 he was a locomotive engineer on the Little Miami Railroad. During the latter year he was promoted to assistant master mechanic in charge of the shops at Columbus, Ohio, which position he held until 1873, when he became superintendent of the Kentucky Central. From 1874 to 1885 he was general master mechanic of the Ohio & Mississippi and in the latter year he resigned to become superintendent of the Brooks Locomotive Works, which position he held for three and one-half years, when he entered the employ of the Pittsburgh Locomotive Works as general traveling agent. In November, 1902, he was appointed western representative and traveling agent for the American Locomotive Company with headquarters at Chicago, which position he held until October 1, 1903, when he became general sales manager for Jerome & Elliott.

J. H. Setchel

Railway Mechanical Engineer

Vol. 98 February, 1924 No. 2

Systematizing Car Repairs

In an article, elsewhere in this issue, H. W. Williams suggests a plan for systematizing heavy car repair operations, which holds splendid possibilities not only for reducing the out-of-service time of cars undergoing heavy repairs, but for a marked reduction in the labor cost of performing the work. The suggestion is simply that one shop on a system, or a part of a shop, as circumstances require, be set aside and specially organized for heavy repairs on a single series of cars which, at the time, have reached the age when a general overhauling is advisable. It is unnecessary to dwell on the many possibilities for economy which the regular progress of cars of a single series, each receiving identical repairs, renewals and betterments, offers to the shop management. One of the important ones mentioned by the author, is the increased labor output resulting from the high degree of proficiency obtained by the gangs in performing identical operations on one or two thousand cars of precisely the same design. This could be obtained with no more facilities than are usually provided where no effort is made to segregate by series the cars going through the shops. But with a thousand or more cars of the same series to work on, the railroad shop will find the same justification for the careful planning of special facilities and tools, some of which may even be of little use on any other design, that the builder has when he lines up his plant preparatory to the construction of an order of new cars.

But there is another aspect of this situation, which is also deserving of attention. Few railroads have adequate shop facilities for the handling of heavy car repairs. The slow progress through the shops of cars of miscellaneous series taken into the shop as they come, is a condition which must be accepted. If the rapidity with which cars may be put through the shop where the work has been planned and the material prepared in advance, reduces the loss of service time for the cars, then conversely it increases the output capacity of the existing car shop space. Mr. Williams' suggestion already has many adherents but, in general, its possibilities are only just beginning to be realized.

Help Solve the Hot Box Problem

A letter recently received from a car foreman on a middle western railway contained the following statement: "Regarding the hot box situation at the present time, while it may seem startling and almost unbelievable, I sincerely believe that with proper and general co-operation in the maintenance of all parts in this connection, that a 50 per cent improvement in results and savings can be made. . . ." That the writer of this letter is not entirely unjustified in his belief is evident from the fact that within the past two years, his company has been able to reduce its guarantee with the oil company from 12 cents to 5 cents per one thousand car miles.

But the cost of lubrication is perhaps the least important result to be obtained by improvement in journal box conditions. The delay to cars, which have to be set out because of hot boxes, with resulting losses and annoyance to shippers and consignees, the tremendous increase in operating costs caused by the train delays, the excessive cost of repacking boxes at isolated points on the line, and the risk of serious accident which hot boxes always entail, together makes them one of the worst enemies of economical and safe operation. The subject is not a new one; it has been discussed as long as cars have run on rails. But there are few men responsible for the condition of rolling stock, who do not still carry with them a subconscious dread of a hot box epidemic, with which they may suddenly be confronted almost without warning. These epidemics, of course, all eventually yield to treatment—but treatment the administering of which often goes far toward completely upsetting the department.

What measures will prevent the recurrence of these epidemics? It was in order to find an answer to that question this in the January issue, we offered a first prize of $50 and a second prize of $35 for the two best papers describing measures which have been successful in effecting a definite and permanent improvement in the hot box situation, and setting forth specificially just what the results have been. If measures in effect on your road are such as to justify your concurrence, even partially, in the statement just quoted, there are many others who will be deeply interested in learning of them. Let us have your contribution on or before March 1, 1924. Should you not be a prize winner, your paper, if published, will be paid for at our regular space rate.

Helping Executives to Think Straight

In the first prize article in the shop management competition, submitted by Frank J. Borer of the Central Railroad of New Jersey, and published in our January issue, emphasis was placed upon weekly meetings of the supervisory forces and also upon lecture and discussion courses for the executives, such as have been developed by the Pennsylvania Railroad during the past three years. It is of interest to note that although the first course of this kind on the Pennsylvania was tried out at Harrisburg two years ago when 308 members were enrolled, such clubs or courses are now functioning at nine different points in the Eastern Region of the Pennsylvania System, with a total enrollment of 3,400 foremen and other supervisory officers.

Railroad mechanical departments generally are giving more and more attention to meetings of this kind for the executives, and to other forms of staff meetings and conferences. These promise to be a strong factor in eliminating bureaucratic methods and in developing a fine spirit of co-operation and initiative. This is true, whether the movement includes only representatives of the mechanical department, or gatherings of the supervisory staff of all departments located at a given place or division. There has in many cases been too much unnecessary intra-department and inter-department correspondence. When men come together

frequently in conference they appreciate and understand each other much better and as a result a lot of useless and sometimes wasteful correspondence can be eliminated and a purely mechanical intercourse can be supplanted with one based on a real spirit of co-operation and understanding.

Then, too, the fact is becoming more and more generally recognized that the controlling and directing of men is an art or a profession, rather than a job. The days of the driver are numbered and it is only a question of time when men of this type will be entirely supplanted by men with real leadership ability. As a matter of fact, there has been a slow but steady tendency in this direction for many years. This tendency is being accentuated now because of the remarkable advance which has been made in recent years in developing an understanding of the underlying principles involved in the successful directing of men, and also because of the developments in the labor union field, as well as among the workers in general.

It is important, therefore, that those who are engaged in directing men should have a thorough understanding of the simple principles underlying successful management and should know how to apply them. This is one of the most important functions of the so-called executives' club.

Because of the widespread interest in the development of this movement on the railroads, we are particularly fortunate in being able to present elsewhere in this number an article on executive clubs by Simeon van T. Jester, superintendent of Trade School, Girard College, Philadelphia, Pa.

Possibilities of a Diesel Locomotive

From time to time someone comes forward with the statement that the days of the steam locomotive are numbered and this is frequently accompanied by a prophecy that our old friend will soon be supplanted by its electric brother. Others hold to the belief that the successor of the steam locomotive will be one driven by an internal combustion engine. When innovations in the design of either locomotives or cars are proposed, most railroad men at once assume a "show me" attitude, or at least indicate that, as far as they, themselves, are concerned, they propose to wait until someone else has done the pioneer experimental work. Conservatism may, however, be carried too far. The steam locomotive has, still is, and for some time to come doubtless will continue to render a good account of itself. It is a comparatively simple piece of machinery; it can be built in types and sizes suitable for all conditions of service; builders, repair shops and terminals furnish facilities for construction and repair; designers and mechanics have been educated to attend to its requirements. However, despite its good points, its thermal efficiency is low, its stand-by losses are large and the time spent on the road in revenue-earning service is far less than that spent at terminals and shops.

Probably comparatively few railroad men realize the strides made during the last decade in the development of the thermal combustion engine of the heavy oil type to which the name Diesel is usually attached. The thermal efficiency of such engines is high; they can be operated continuously for long periods of time; their stand-by losses are insignificant. As arguments against their widely extended adoption, it must be recognized that they are frequently heavy, bulky, complicated and of relatively high initial cost. They also possess certain characteristics which make their application to locomotive service far from an easy problem. Probably the most difficult of these problems is that of transmission, particularly in the larger units, and associated with this is that of starting under heavy load. Weight has often been a reason for not using Diesel engines in the past, but this objection has largely been overcome in the development of a high-speed engine for use in submarines. Without the Diesel, the submarine would not be the practical and effective device it is.

Engineers, both here and in Europe, are working hard on the problem of the Diesel locomotive. The limitations and requirements are better understood today than they ever were before and this makes possible an intelligent handling of the issue. With suitable encouragement, the next few years should show rapid progress in the development of engines and transmissions for practical thermo locomotives for at least some American railroad traffic conditions.

Competition on Machine Shop Production Jobs

How many schedule delay reports show that the locomotives in the shop are being held waiting for rods, motion work, or driving boxes from the machine department? These are the key jobs of all those capable of being organized on a production basis. Experience shows that in many cases the output of the entire locomotive repair shop is limited by the capacity of the machine department to repair the many rods, motion work parts and driving boxes which must be thoroughly overhauled before they can be reassembled on locomotives and the locomotives returned to service. It frequently happens that machine shops of ample capacity to handle the normal number of heavy repairs are completely upset in their schedules by the advent of light repair locomotives, which almost always require rod work, and by parts sent in from roundhouses for what amounts to practically heavy repairs. The importance of organizing machine departments to have an excess capacity for handling this work and thus prevent locomotive delays can hardly be overestimated. Locomotives cannot earn revenue while waiting for parts and there is a heavy interest charge for each day of idle locomotive time.

What are you doing to organize the rod job, the motion work job or the driving box job in your machine department for greater production efficiency? The *Railway Mechanical Engineer* offers three prizes of $50, one each for the best article relating to each of these three important branches of machine shop work. In some shops new machines have been installed that have greatly reduced the labor involved in one or another of these jobs. In other shops one or more of the jobs has been organized in such a way that the work progresses from one machine to another without back travel and is thus speeded up. In still other shops the work has been specialized and men trained to handle particular phases of it, thereby developing great proficiency with a corresponding reduction in the time required for handling locomotive parts in the machine department.

We believe that in some railroad shops the problem of promptly handling repairs to locomotive rods, motion work or driving boxes has been successfully solved. We believe that those responsible for this success, aside from the inducement offered by the three prizes, should be willing to describe their practices for the benefit of other railroad men who may thereby find suggestions for improvements in their own practices. The author of the paper on the best practice in each phase of the work mentioned will receive a check for $50, but any other articles published will be paid for at regular space rates. Articles will not be judged on their literary merit but on the value and practicability of the methods described.

In general, each article should be comprehensive and relate to the entire job which it is designed to cover, but any single suggestion of value will be accepted and paid for at regular space rates. It is highly important that as many photographs and drawings as possible be submitted to illustrate either the progress of the work through the department, new machines used or effective labor-saving jigs and fixtures which have been developed. In the interests of greater machine shop efficiency if you have a rod gang, motion work

gang or driving box gang organized to produce results of which you are proud, tell us about it. The competition closes April 1.

A Planning Department

The second prize article in the competition on shop management will be found on another page of this number. In contrast to the first prize article, which was published last month, it concentrates upon one particular phase of shop management—the desirability of forming a planning department with a view to increasing the man-hour output. Attention is directed to the remarkable results that have been obtained in various industries through careful research and planning, in the effort to promote more efficient and more economical production. As the writer suggests, railway officers sometimes evade this question by indicating that the work in railroad shops is largely in the nature of repair work and that methods and practices used in a manufacturing plant cannot be used to advantage. He frankly challenges this statement.

There would appear to be a large opportunity for developing the sort of planning department that is suggested, particularly in the larger shops. It would serve to concentrate in a more scientific way the energies of a splendid group of mechanical geniuses in railroad shops, who have contributed in a wonderful way to the improvement of shop equipment and shop practices. Possibly no more striking illustration of the remarkable work which has been done by these men can be found than in the shop kink and shop practice articles which have appeared in the *Railway Mechanical Engineer* and its predecessors. Too high tribute cannot be paid to the ability and efforts of the men who have been responsible for perfecting these devices and processes and for bringing them to the attention of railroads at large through our columns. A planning department, such as is suggested in the article by Mr. Williams, would apparently allow for a wider development of the energies of these men and would recognize their abilities in a larger way. The suggestion is worth careful and thorough consideration.

It is fitting in this connection to recognize also some of the various clearing houses through which many of these men have made their ideas available to the railroads in general. These would include the various minor mechanical department associations and some of the local foremen's clubs or associations.

While Mr. Williams deals almost entirely with the more simple processes, it is not out of place to call attention to some of the larger ways in which the planning department could be helpful, even though the working out of the final plans might require the combined consideration and efforts of all of the supervisory staff at the shops. An instance of this would be the development and application of shop schedules, which have frequently been commented upon in these columns and which have steadily been receiving more and more consideration in recent years.

Developments of the past seven or eight years have clearly indicated the vital importance of equipment maintenance. The costs per unit of output have been steadily rising and to offset this it is necessary to adopt every possible provision to increase the man-hour output and to secure the best possible utilization of material. The amount of money at stake is so great and the necessity for reducing costs to a minimum is so vital in the interests of the public, the employees and other investors that every possible effort should be made to approach the problem in a logical, common-sense, scientific way, and to utilize all of the potential ingenuity that may be lying dormant among the workers and the supervisory staff. These dormant forces should be released so that they can function to as great a degree as possible. Mr. Williams has one suggestion for bringing about this liberation of forces.

A Word of Caution

There is hardly a railroad shop in the United States that has not recently been required to break previous records in production and repair work. In order to do this, many shops have devised scheduling systems, installed new methods of routing or reorganized the entire system of management. This has all meant a big forward step in railroad shop production. However, a word of caution at this time is not inopportune. The installation of proper scheduling systems and new methods of routing requires a certain knowledge of the principles of industrial engineering. The fundamentals of good system are simplicity and efficiency. When system is lacking in these characteristics, it is well named "red tape." These fundamentals have been learned through years of bitter experience, and for this reason the growth of industrial engineering has been replete with failures as well as successes.

A specific case in point is that of an industrial concern which had to reorganize and increase its capacity during the emergency created by the war. The industrial engineer sent to take charge of the work had a plan of organization of which he was the originator. This plan was his hobby. In this instance, however, he rode his hobby too far. In a short time the concern found itself in such a condition, war profits and all, that it could not pay its overhead expenses. Another case is that of a manufacturer of gas and gasoline engines. This company, without seemingly making a careful analysis of the work at hand, went to the expense of moving practically every machine in its shops to new locations in order to install a new system of production that looked very well on paper. However, the system did not operate satisfactorily and other systems were tried out. The entire shop was entirely rearranged four times in a period of nine months.

In following up the success of scheduling systems in various railway shops, it has been noted that where some scheduling systems have been installed, they have gradually died out, or have gone through such radical changes that the original system can not be recognized. It such cases, one cannot help but feel that the system was a failure or that the management was blindly experimenting.

There is no reason why the railroads should not profit by the mistakes and experience of other industries. A mistake in the purchase of a proper machine tool is, to a certain extent, easily rectified, and the total loss of money involved is very small in proportion to the amount invested in the plant. On the other hand, a mistake in the proper selection of a shop scheduling system or type of organization is a more serious matter. The time it takes to recover and the demoralizing effect on the plant personnel and shop output in itself makes the experiment expensive. Yet a scheduling system is often installed with less thought and consideration than that expended in the purchase of a new machine tool. A careful and scientific study of shop conditions will tend to eliminate the experimental factor in introducing new systems. It is practically essential, before installing a new system, that sufficient preliminary study and investigation be made to insure its success under the local conditions.

Advanced Apprenticeship Methods

While the two prize articles in the regular apprentice competition have some few points in common, it would be difficult to imagine a greater contrast than is presented by the second prize article, which is published in this number, and the first prize article, which appeared in our January issue. The first prize article gave an apprentice's conception of, and constructive suggestions on, an ordinary type apprenticeship system, while the second prize article comments upon and makes constructive suggestions on what is undoubtedly the best railroad

apprenticeship system in the world—indeed, it may be questioned whether its method and spirit have been surpassed by an apprenticeship course in any industry. Mr. Price, the winner of the second prize, like so many of the other apprentices from whom contributions have been received, is apparently far more interested in the effectiveness of the apprenticeship training methods than these young men are usually given credit for.

We had hoped when we announced the two apprentice competitions that the boys would give us their real impressions and that they would be frank in making suggestions, based on their viewpoints. We have had the feeling that just as educators have improved their methods as they have been led to see things from the viewpoints of the students themselves, so the railroads might profit in developing their apprenticeship systems, if they could get a greater appreciation of the boys' viewpoint. As a matter of fact, one reason why the aggressive apprenticeship systems are so effective is because specialists who had charge of them have taken pains to discover the needs of the boys and to find out exactly how they felt about the efforts that were being made to train and educate them. We were, therefore, agreeably surprised when we found how frankly the boys expressed themselves in their contributions.

In our opinion, if steps could be taken on every important railroad to get a better understanding of the boys and their needs and then earnestly try to meet them—utilizing the experience that has been gained by the leaders in the development of railroad apprenticeship methods—the cost of so doing would be insignificant as compared with the results that would follow—and the results would not be so far in the future as might be expected.

One reason why this issue has not been faced up to to a larger degree in the past, has been that those in charge were thinking more in terms of the present than of the future. It has been demonstrated, however, in a most unmistakable manner, that the introduction of modern apprenticeship methods pays almost from the start and that returns begin to come in in a large way within a reasonably few years. Not a few men in these days are taking out shares in building and loan assocations which will not mature for eleven or twelve years. Appreciable returns on a real apprenticeship system can be expected within such a period. It is just as important that the railroad managements should safeguard their future as it is for the individual to attempt to safeguard his future.

New Books

Traveling Engineers' Association Proceedings. *Edited by W. O. Thompson, Secretary, Cleveland, Ohio. 436 pages, 5½ in. by 8½ in. Bound in cloth.*

A wealth of material of interest to traveling engineers, road foremen of engines and others is contained in this report of the proceedings of the thirty-first annual convention of the Traveling Engineers' Association, held at Chicago, September 11, 12, 13 and 14, 1923. Following a list of the 1923-1924 officers in the front of the book is the constitution of the Traveling Engineers' Association and a brief report of the subjects considered at each convention since the first held at Chicago in 1893. The report is divided into seven parts, one for each session of the association and the papers are presented in the order in which they were read. These papers have been for the most part printed in full or in abstract in the Railway Age and *Railway Mechanical Engineer* and their character and generally high quality are well known. A comprehensive index in the back of the book enables any of the papers, as well as the discussions by the various members, to be located readily.

What Our Readers Think

Reason for Counterbore in Air Pumps

Chicago.

To the Editor:

I am submitting the following series of questions that have been propounded by our air brake foreman, and would be pleased if you consider them of sufficient importance to submit to your readers, to have you do so.

1—A discussion has come up in our air brake department as to the real necessity of counterboring the cylinders of 8½-in. cross-compound air pumps on the end next to the center casting when reboring. If this counterboring was eliminated, what effect would it have on the running of the pump?

2—What is the counterbore in this end of the cylinder intended to accomplish?

3—Without the counterbore, would we not have a wider gasket space from the ports to the cylinder?

4—In reboring air pump cylinders in general on a horizontal boring mill, it is somewhat difficult to rebore this counterbore, and I am asking just why it is necessary.

Shop Superintendent.

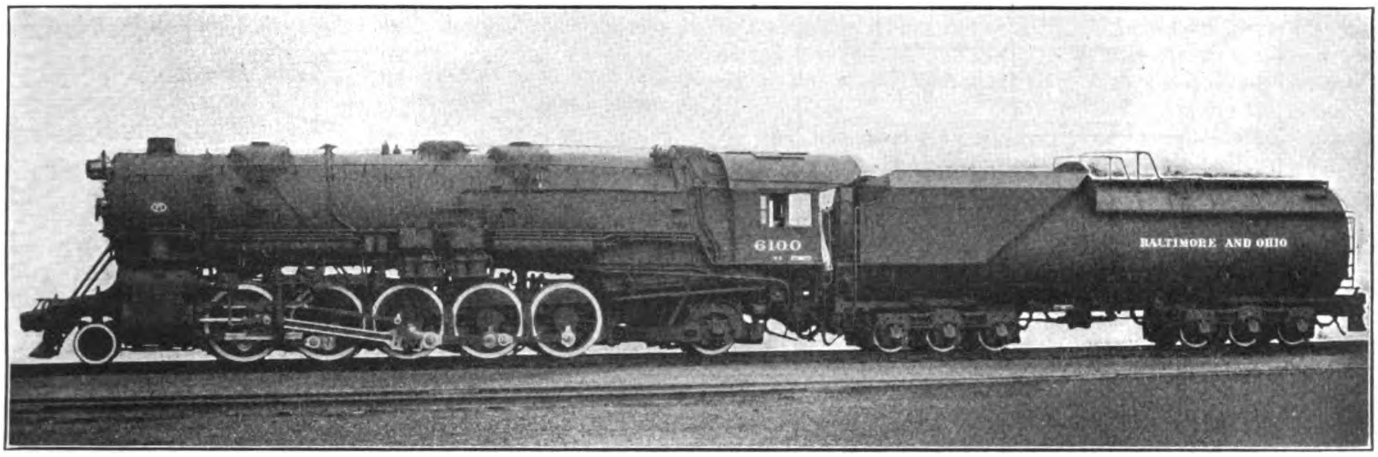
(The fundamental reason for counterboring the cylinders of the 8½-in. cross-compound, or any other air compressor, is to facilitate the application of piston rings and the insertion of pistons complete with rings. The length of the counterbore should be such that one of the rings will pass slightly beyond the counterbore at the end of the stroke and thus avoid the wearing of a shoulder, which would make it necessary to use a ring of too smaller a diameter in partly worn cylinders which would be the case were a counterbore not employed.

The elimination of the counterbore would not affect the normal operation of the cross-compound air compressor. If compressors are rebored in railroad shops and, in particular, if they are bored with cylinders and center piece attached, the reboring of the counterbore next to the center piece is hardly necessary and could be omitted without injury. If shop facilities and methods are such that the counterbore next to the center piece is inconvenient to handle, it would seem practical to omit it. This will avoid decreasing the gasket space between ports and cylinder. To facilitate the entrance of the rings, the counterbore at the outer ends of the steam and air cylinders next to the heads should preferably be maintained of the usual standard length, although the large diameter need not be proportionately increased when the cylinder is rebored.

In reboring cross-compound air compressor cylinders, care should be taken to see that the grooves at the lower end of the low pressure steam cylinder are maintained at the standard depth used in new compressors.

In single-stage air compressor cylinders, there is a straight counterbore ¼ in. deep to receive the projections on the heads and center piece and thereby insure alinement. These should, of course, be retained of the standard diameter in such compressors. In cross-compound compressors, however, the alinement of the cylinders with the heads and center piece is by means of dowel pins. For this reason, the straight portion of the counterbore was omitted when this design was made.

In connection with this subject, we would be pleased to hear what is the practice followed in different railroad shops.—Editor.)



The Baltimore & Ohio Ordered 75 Class S-1 Type 2-10-2 Locomotives in 1923

Heavy 2-10-2 Type Locomotives for B. & O.

Tractive Force of 84,260 Lb. Obtained with 64-in. Drivers; Tenders of Unusual Capacity Facilitate Long Runs

ONE of the outstanding locomotive orders of 1923 was that of the Baltimore & Ohio for 75 locomotives of the 2-10-2 type. This order was notable not only on account of the number of engines and the type, but also for their exceptionally heavy weight, large hauling capacity and tenders of an unusual size designed to facilitate long runs by cutting out stops for fuel or water. The order was divided between the Baldwin Locomotive Works and the Lima Locomotive Works, the former receiving 50 and the latter 25. These locomotives weigh 436,510 lb. in working order, have 30-in. by 32-in. cylinders, 64-in. drivers and a rated tractive force of 84,260 lb. In weight and tractive force, they represent practically the maximum yet obtained in a non-articulated locomotive. Such locomotives with an axle load of practically 70,000 lb. can, of course, be operated only on roads where the track and bridges are of the heaviest description.

A comparison between these locomotives and those of the same type recently ordered by the other roads is given in the table below.

Road	Weight, lb.	R. T. F.	Cylinders, in.	Drivers, in.
B. & O.	436,510	84,260	30 x32	64
U. P.	379,000	70,450	29½x30	63
I. C.	382,000	73,800	30 x32	63
S. P.	398,000	75,150	29½x32	63½
G. N.	423,340	87,000	31 x32	63

Except on the mountain divisions where Mallet locomotives are employed, the standard heavy road engine of the Baltimore & Ohio is a Mikado. The latest of this type, B. & O. Class Q-4b, of which 85 were ordered from the Baldwin Locomotive Works in 1922, weighed 327,430 lb., had 26-in. by 32-in. cylinders, 64-in. driving wheels and a rated tractive force of 63,200 lb.

The 2-10-2 type locomotive is, however, not new on the B. & O. The last of this type to be placed in service were a lot of 30 built by the Baldwin Locomotive Works in 1914 and designated as Class S. They weighed 410,000 lb., had 30-in. by 31-in. cylinders, 58-in. driving wheels and carried a boiler pressure of 200 lb. These proportions gave a rated tractive force of 84,400 lb. They have been used in both road and pushing service and have proved especially satisfactory in the latter class of work, the majority now being employed on the Connellsville division as helpers on the Sand Patch hill where the grade is 1.98 per cent.

The new 2-10-2 type locomotives, designated as Class S-1, have 33½ per cent greater tractive force than the Mikado type and are designed to combine the hauling capacity of the old Class S with the higher speed capacity of the Class Q-4b, and with this end in view, they also have driving wheels 64 in. in diameter. These are probably the largest driving wheels ever used on a 10-wheel coupled locomotive, and they fit the new design not only for heavy grade service, but also for work on divisions having moderate grades where it is desired to haul an increased tonnage as compared with the Mikado type locomotives, while maintaining practically the same speed.

The Class S-1 locomotives are designed to traverse curves of 16 deg. and have a maximum height of 15 ft. 5⅜ in., a maximum width of 10 ft. 11 in., and an overall length, engine and tender, of 100 ft. 8¼ in.

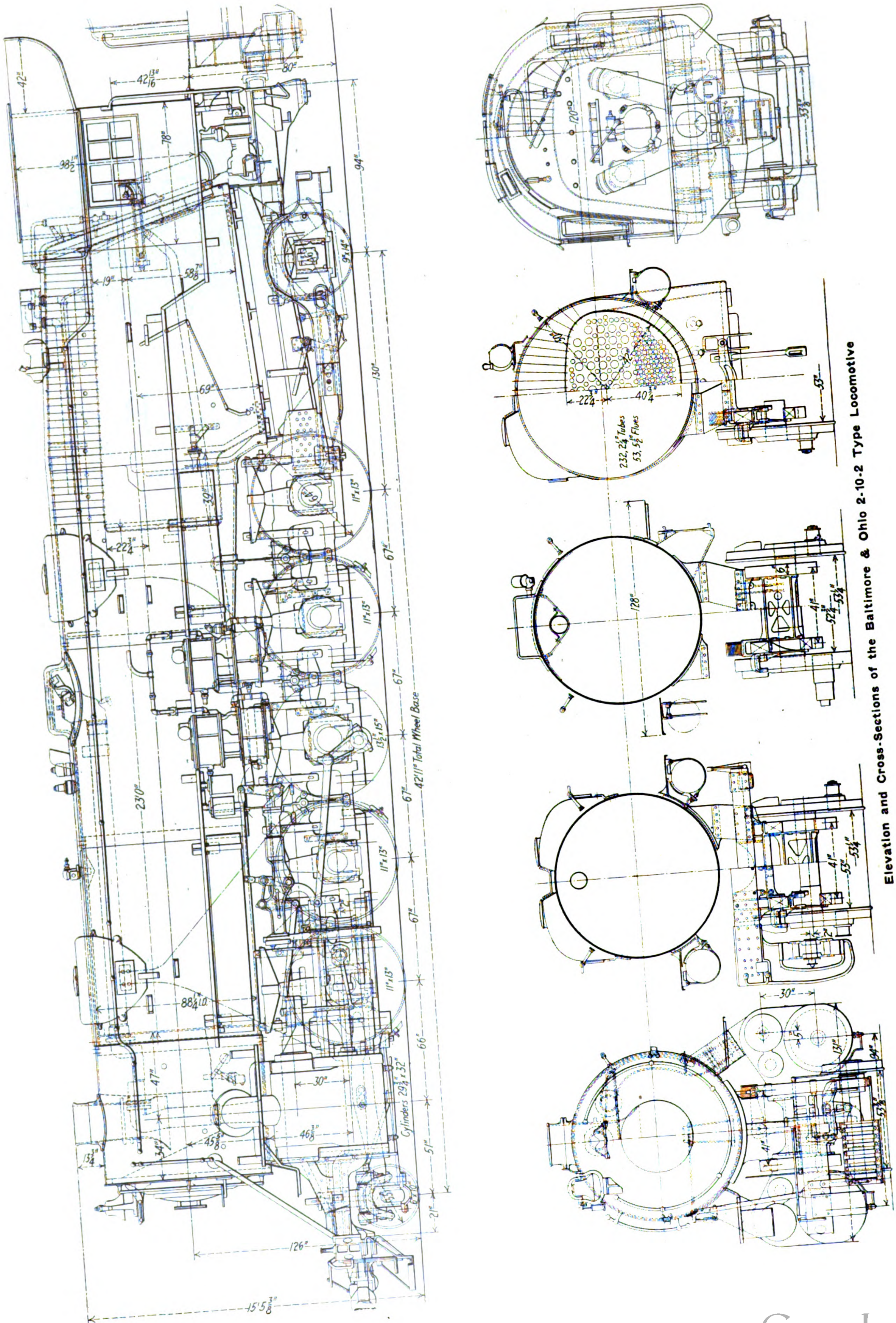
The weight in working order of the engine only is 436,570 lb., of which 347,230 lb. is on the drivers, 31,750 lb. on the front truck and 57,710 lb. on the trailing truck. The weight of engine and tender complete in working order is 730,000 lb.

The Boiler and Accessories

The boiler has a straight top with a slope on the bottom at the rear end to give ample water space under the combustion chamber. The steam pressure carried is 220 lb. The evaporative heating surface consists of 5,270 sq. ft., of which 389 sq. ft. are in the firebox, arch tubes and combustion chamber and 4,881 sq. ft. in the tubes and flues. The superheater is the Type A and contains 1,512 sq. ft. of surface in the 54 double loop units. The firebox is 132⅛ in. long and 96 in. wide and has a combustion chamber 39 in. long. The brick arch is supported on five water tubes. The firebox has a complete installation of Tate flexible staybolts.

The grate area, 88 sq. ft., is the same as in the Class S locomotives and the grate castings are interchangeable in the two designs.

The locomotives are equipped with Duplex stokers and the feedwater supply to the boiler is by Hancock H. N. L. injectors of 6,000 gal. per hour capacity. Other boiler fittings include Franklin automatic firedoor No. 8, three Coale 4-in. safety valves, two 2-in. Okadee blow-off cocks, Ashton iron case steam gages, Wiltbonco reflex water glasses,



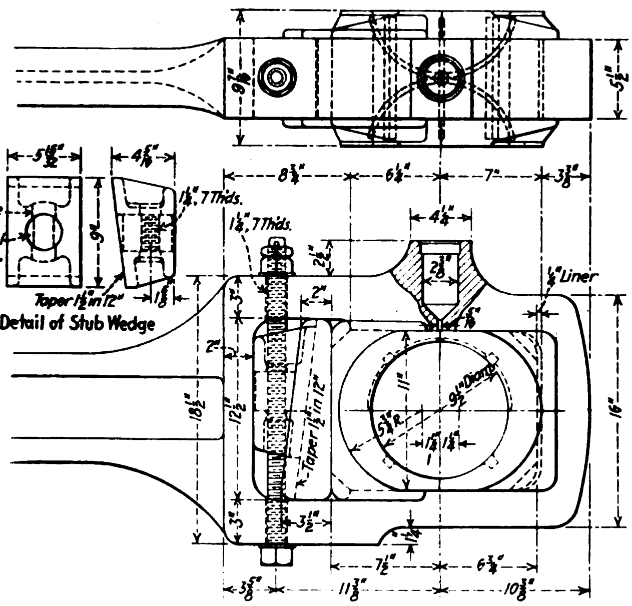
Elevation and Cross-Sections of the Baltimore & Ohio 2-10-2 Type Locomotive

and Okadee blower valves with 1¼ in. quick opening. The ash pan is a Commonwealth cast steel design.

Engine and Running Gear

The cylinder diameter is nominally 30 in., but the cylinders are bored, when new, to a diameter of 29¾ in., while the machinery is of sufficient strength for the full 220-lb. steam pressure with the cylinders rebored to a diameter of 30½ in. The cylinders and steam chests are fitted with gun-iron bushings, and this material is also used for the valve packing rings and the piston bull rings and packing rings. The piston heads are of rolled steel and the piston rods are of carbon vanadium steel, normalized. The crossheads are fitted with the Rogatchoff adjustable device, which permits of adjusting the shoes to compensate for wear.

Carbon vanadium steel, normalized, is used for the main and side rods. The main rods have the Markel type of back end. The Markel main rod stub is not new, having originated some years ago on the Chicago & North Western, and has since been used on a large number of heavy locomotives. It is so designed that the brasses can be removed without



Markel Main Rod Stub End

taking down the entire stub. The design as used on these locomotives is shown in one of the illustrations.

Baker valve motion is used and the gears are controlled by a hand screw reverse, similar to that applied to the last Pacific and Mikado type locomotives purchased by the B. & O.

The frames are 6 in. wide and are spaced 41 in. between centers transversely. An exceptionally strong double front rail construction, similar to that used on the latest B. & O. Mikados, is applied to these locomotives. The frame rails are bolted to a strongly ribbed front deck casting, which is in turn bolted to the cylinder castings, forming a most substantial construction. The cast steel cross ties interchange as far as possible, with those used on the Mikado type. The rear frame is of the Commonwealth cast steel cradle pattern and the trailing truck is of the Delta type, so designed that the locomotives can subsequently be equipped with boosters should this appear desirable.

The tires on the front and rear pairs of driving wheels are set 53 in. between their inside faces, and those on the second and fourth pairs, 53¼ in., while the middle (main) wheels have plain tires. The driving and truck axles are made of hammered open-hearth steel.

A Franklin unit safety drawbar and spring type radial buffer are used to connect the engine and tender. The coupler on the tender is the A. R. A. standard Type D with 6-in. by 8-in. shank and X. L. T. release rigging. The draft gear is the National Type H-1a, with Farlow attachments.

The cab is of sheet steel, wood lined. Among the specialties used on these locomotives are the following: Pyle-National Type E-2, turbo generator with headlight having an aluminum case and a 14-in. reflector; Armspear unified pressed steel electric classification lamp; Chambers single-seat dome throttle; Sellers drifting valve; Osche improved pneumatic bell ringer; Hanlon double pneumatic sander; Detroit No. 2 five-feed main lubricators of five pints capacity; and Elvin driving box lubricator.

The air brake is Westinghouse, Schedule 6-ET, with two 8½-in. cross-compound air compressors of 120 cu. ft. capacity on the left-hand side of the boiler. The main reservoirs have a combined capacity of 75,600 cu. in. and are fitted with Franklin flexible joints. The air connections between the engine and tender have McLaughlin flexible fittings. The driver brake is operated by two 14-in. by 12-in. and two 12-in. by 10-in. brake cylinders. The air gage is an Ashton quadruplex.

Tender

The tender is, in its way, quite as remarkable as the engine itself. It is the largest tender thus far completed by the builders, and its use will undoubtedly result in more economical operation by making possible longer runs without stopping for supplies. In this way not only is time saved, but the possibility of damage to couplers and draft gear is materially reduced.

The tender is carried on two six-wheel trucks of the Commonwealth cast steel type. The wheels are of forged steel, 33 in. in diameter, and the journals, measure 6 in. by 11 in. The truck side bearings are of the Stucki anti-friction type. The tender frame is a one-piece Commonwealth steel casting weighing 17,500 lb. The Vanderbilt tank has a diameter of 9 ft. 6 in. and a length of 40 ft. 5 in. The tank capacity is 15,800 U. S. gal., and the fuel space, which has a width of 10 ft. 6 in. carries 23 tons of coal.

Further particulars of these interesting locomotives are given in the accompanying table of dimensions, weights and proportions.

Railroad	Baltimore & Ohio
Type of locomotive	2-10-2
Service	Heavy freight
Cylinders, diameter and stroke	30 in. by 32 in.
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1 in.
Exhaust clearance	0 in.
Lead in full gear	¼ in.
Weights in working order:	
On drivers	347,230 lb.
On front truck	31,570 lb.
On trailing truck	57,710 lb.
Total engine	436,510 lb.
Tender	293,500 lb.
Wheel bases:	
Driving	22 ft. 4 in.
Rigid	22 ft. 4 in.
Total engine	42 ft. 11 in.
Total engine and tender	89 ft. 10⅞ in.
Wheels, diameter outside tires:	
Driving	64 in.
Front truck	33 in.
Trailing truck	46 in.
Journals, diameter and length:	
Driving, main	13½ in. by 15 in.
Driving, others	11 in. by 13 in.
Front truck	6 in. by 10 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	220 lb.
Fuel	Soft coal
Diameter, first ring, inside	88¼ in.
Firebox, length and width	132¼ in. by 96 in.
Height mud ring to crown sheet, back	77⅞ in.
Height mud ring to crown sheet, front	91¾ in.
Arch tubes, number and diameter	5—3 in.
Combustion chamber length	39 in.
Tubes, number and diameter	232—2¼ in.
Flues, number and diameter	53—5½ in.
Grate area	88 sq. ft.

Heating surfaces:
- Firebox and comb. chamber ... 347 sq. ft.
- Arch tubes ... 42 sq. ft.
- Tubes ... 3,132 sq. ft.
- Flues ... 1,749 sq. ft.
- Total evaporative ... 5,270 sq. ft.
- Superheating ... 1,512 sq. ft.
- Comb. evaporative and superheating ... 6,782 sq. ft.

Tender:
- Style ... Vanderbilt—6 wheel trucks
- Water capacity ... 15,800 gal.
- Fuel capacity ... 23 tons

General data estimated:
- Rated tractive force, 85 per cent ... 84,260 lb.
- Cylinder horsepower (Cole) ... 3,568 hp.
- Boiler horsepower (Cole) (est.) ... 3,027 hp.
- Speed at 1,000 ft. piston speed ... 35.7 m.p.h.
- Steam required per hour ... 74,214 lb.
- Boiler evaporative capacity per hour ... 62,950 lb.
- Coal required per hour, total ... 11,590 lb.
- Coal rate per sq. ft. grate per hour ... 132 lb.

Weight proportions:
- Weight on drivers ÷ total weight engine, per cent ... 79.6
- Weight on drivers ÷ tractive force ... 4.12
- Total weight engine ÷ cylinder hp. ... 122.3
- Total weight engine ÷ boiler hp. ... 144.2
- Total weight engine ÷ comb. heat. surface ... 64.4

Boiler proportions:
- Boiler hp. ÷ cylinder hp., per cent ... 85.
- Comb. heat. surface ÷ cylinder hp. ... 1.90
- Tractive force ÷ comb. heat. surface ... 12.42
- Tractive force × dia. drivers ÷ comb. heat. surface ... 795.
- Cylinder hp. ÷ grate area ... 40.55
- Firebox heat. surface ÷ grate area ... 4.42
- Firebox heat. surface, per cent of evap. heat. surface ... 7.4
- Superheat. surface, per cent of evap. heat. surface ... 28.7
- Tube length ÷ inside diameter ... 138.

Locomotive Orders and Types in 1923

Heavy Additions to Motive Power Follow Large Orders of Past Two Years; Three-Cylinder Locomotives a Noticeable Feature

ORDERS for locomotives placed in 1923 aggregated 1,944 for domestic use, 82 for Canada and 116 for export, a total of 2,142. In 1922, locomotive orders were made up of 2,568 for domestic use, 68 for Canada and 143 for export, a total of 2,779. While the orders were over 600 less in 1923 than in 1922, the number of locomotives built was considerably in excess of the number ordered. The number built in 1923 for domestic service was 3,362, considerably more than twice the figure of 1,303 for 1922. This is explained by the fact that the majority of orders for the past two years were placed in the last half of 1922 and the first quarter of 1923.

By reference to Table I, which summarized the orders since 1915, it will be noted that during the years 1916, 1917 and 1918, the number of locomotives ordered were not only exceptionally heavy for domestic service, but the number for export average approximately an equal figure. During the past two years the export business has been unusually light. The largest export order during the year was for 25 Mikado locomotives for the Chilean State Railways.

Table I—Orders for Locomotives Since 1915

Year	Domestic	Canadian	Export	Total
1915	1,612	...	850	2,462
1916	2,910	...	2,983	5,893
1917	2,704	...	3,438	6,142
1918	2,593	209	2,086	4,888
1919	214	58	989	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,568	68	143	2,779
1923	1,944	82	116	2,142

Prior to 1918 Canadian orders were included under "Domestic."

According to the reports of the Car Service Division, which now makes monthly reports of locomotive installations and retirements, the Class I railroads installed 3,704 locomotives in the first eleven months of 1923. This figure, however, includes not only new locomotives, but also rebuilt locomotives on which the repair work was sufficiently large in amount so that under accounting rules the equipment must be retired and entered in the accounts as new. The figure given is significant, because it is larger than for any full year since 1913 and reflects the great amount of progress made in the railway motive power situation during the year recently closed.

On December 1, 1923, according to the Car Service Division, American railroads owned 64,878 locomotives as compared with 64,512 at the opening of the year. The increase in motive power capacity, however, has been much greater than these figures alone would indicate because of the replacement of older and lighter power by new locomotives of larger size, which added considerably to the total locomotive tractive force. Although the total number of locomotives was increased only 366 during the eleven months' period, the increase in total tractive force was 131,000,000 lb., making the total at the end of November 2,532,051,290 lb.

The total capital expenditure of the American railroads in 1923 has been estimated at $1,075,897,940. Of this amount $212,225,204 was spent for locomotives.

Table II—Important Locomotive Orders in 1923

	0-6-0	0-8-0	2-8-0	2-8-2	2-10-0	2-10-2	Mallet	4-6-0	4-6-2	4-8-2
A. T. & S. F.	..	..	..	30	..	..	..	..	..	..
A. C. L.	..	20	..	7	..	..	..	..	25	..
B. & O.	..	..	..	..	..	75	..	..	..	..
B. & M.	..	..	..	..	..	10	..	..	10	..
B. R. & P.	..	9	..	..	..	..	16	..	5	..
Can. Nat.	10	7	..	8	..	..	..	..	..	..
Can. Pac.	..	..	..	20	..	..	..	..	16	..
C. C. & O.	..	..	..	10	..	..	10	..	..	..
C. of Ga.	..	..	..	10	..	..	..	..	..	10
C. V.	..	8	16	..	..	..	..	..	..	..
C. & E. I.	..	..	..	10	..	..	..	..	..	..
C. R. I. & P.	..	..	..	30	..	..	..	..	..	10
D. L. & W.	..	..	..	10	..	..	..	..	10	5
D. & R. G. W.	..	..	..	10 N.G.	..	..	..	..	..	10
E. J. & E.	..	..	..	15	..	..	..	..	..	..
F. E. C.	5	..	..	..	..	..	..	..	..	15
G. T. W.	3	10	..	10	..	..	..	..	5	..
G. N.	..	..	..	..	..	30	..	..	..	28
I. C.	..	..	..	35	..	..	..	..	..	15
I. H. B.	..	..	..	20	..	..	..	..	..	..
K. C. S.	..	..	..	..	..	..	10	..	..	..
L. V.	..	..	..	40	..	..	..	..	10	..
L. & N.	..	..	..	30	..	..	..	..	6	..
M. P.	..	..	..	40	..	..	..	..	10	..
M. & O.	..	..	..	13	..	..	..	..	5	..
N. Y. C. & St. L.	..	..	..	30	..	..	..	..	6	..
N. Y. N. H. & H.	..	10	..	..	..	..	..	..	..	10
Pennsylvania	37	..	..	..	375	..	..	40	42	1
P. & R.	..	..	25	..	..	..	..	..	..	..
P. & L. E.	..	..	..	10	..	..	..	..	..	..
St. L. S. W.	..	..	15	..	..	..	..	..	..	..
S. A. L.	..	..	..	23	..	..	..	..	..	..
S. P.	20	..	..	..	..	51	..	..	14	28
So.	..	..	..	50	..	..	..	..	16	..
Union	10	..	..	..	..	..	..	..	..	..
Virginia	..	..	..	..	..	..	15	..	..	..
Wabash	20	..	..	30	..	..	..	..	..	..

Types of Locomotives Ordered

In Table II will be found a summary of the more important locomotive orders for the year 1923, grouped according to roads and types. This list includes 1,670 locomotives for 38 railroads, or 90 per cent of the locomotives ordered by American and Canadian roads. The balance was divided into small orders for a number of railroads.

Information as to types will be found in Table III in which orders for railroads, industrial concerns and for export

have been segregated. Similar information for the preceding year will be found on page 79 of the February, 1922, issue of the *Railway Mechanical Engineer*.

Considering only the 1,889 locomotives ordered in 1923 for actual railroad service, it will be observed that 230 or 12.2 per cent, were for switching service. The orders were about equally divided between the 0-6-0 and the 0-8-0 types. The largest single order for switch engines was that of the Pennsylvania for 37 of the 0-6-0 type. The Southern Pacific and the Wabash each ordered 20 locomotives of the same type, while the Atlantic Coast Line ordered 20 of the 0-8-0 type. In 1923, three-quarters of the switch engines ordered were of the 0-8-0 type and only one quarter of the 0-6-0 type.

Locomotives with two-wheel leading trucks and three, four, or five pairs of drivers, which are used almost entirely for

TABLE III—TYPES OF LOCOMOTIVES ORDERED IN 1923

Type	Railroad	Industrial	Export	Total
0-4-0	6	20	0	26
0-6-0	118	37	2	157
0-8-0	106	18	0	124
2-6-0	4	6	0	10
2-6-2	10	9	0	19
2-8-0	71	2	9	82
2-8-2	534	10	36	580
2-10-0	380	0	0	380
2-10-2	167	0	0	167
Mallet	53	5	1	59
4-4-0	0	0	0	0
4-4-2	4	0	0	4
4-6-0	45	0	1	46
4-6-2	194	0	2	196
4-6-4	6	0	0	6
4-8-0	4	0	0	4
4-8-2	140	0	3	143
Miscellaneous	7	3	45	55
Geared	5	25	1	31
Electric	35	2	16	53
Total	1,889	137	116	2,142

freight service, totaled 1,166 or 61.6 per cent of the railroad orders. In this group, the largest number, 534, or 46 per cent, were of the 2-8-2 type. There were also 71 of the 2-8-0 type. Roads which placed orders for at least 20 locomotives of the 2-8-2 type were the Southern; Lehigh Valley; Missouri Pacific; Illinois Central; Atchison, Topeka & Santa Fe; Chicago, Rock Island & Pacific; Louisville & Nashville; New York, Chicago & St. Louis; Wabash; Seaboard Air Line; Canadian Pacific and Indiana Harbor Belt. The only large orders for the 2-8-0 type were those of the Philadelphia & Reading, Central Vermont and St. Louis-Southwestern. Of the 380 locomotives of the 2-10-0 type, 375 were for the Pennsylvania. This was the most important single order

TABLE IV.—PRINCIPAL ORDERS FOR 2-8-0 LOCOMOTIVES IN 1923

Road	No.	Weight, lb.	Cylinders, in.
Philadelphia & Reading	25	315,585	27 x 32
Cambria & Indiana	4	272,000	26 x 30
St. Louis Southwestern	15	243,775	25 x 30
Central Vermont	16	227,000	24 x 32

of the year. In this connection it will be recalled that the same road ordered 100 of the same design in 1922. Orders for the 2-10-2 type include 75 for the Baltimore & Ohio; 51 for the Southern Pacific; 30 for the Great Northern, and 10 for the Boston & Maine.

There were 53 Mallet locomotives ordered in 1923, or less than half as many as the 116 ordered in 1922. The 1923 orders included 16 for the Buffalo, Rochester & Pittsburgh; 15 for the Virginian, and 10 each for the Carolina-Clinchfield & Ohio and the Kansas City Southern.

Of the types usually employed for passenger or express service, there were orders for 393 locomotives, 20.8 per cent of the total ordered by the railroads. Of these, 194 were of the 4-6-2 type, 140 of the 4-8-2 type and 45 of the 4-6-0 type. The largest orders for the 4-6-2 type were 42 for the Pennsylvania and 25 for the Atlantic Coast Line. Other roads ordering 10 or more engines of this type were the Canadian Pacific; Southern; Southern Pacific; Boston & Maine; Delaware, Lackawanna & Western; Lehigh Valley, and Missouri Pacific. The Pennsylvania ordered 40 of the 4-6-0 type. The orders for the 4-8-2 type included 28 for the Great Northern, 28 for the Southern Pacific; 15 each for the Illinois Central and the Florida East Coast and 10 each for the Central of Georgia; Chicago, Rock Island & Pacific; Denver & Rio Grande Western and the New York, New Haven & Hartford. There were orders for only four of the 4-4-2 type and none for the 4-4-0 type.

An unusual railroad order was that of the New York Central for 5 Shay locomotives for special service in New York City.

There were orders for 35 electric locomotives, including 12 for the Virginian, 10 for the Pacific Electric and 2 for the Detroit & Ironton.

Tendencies as to Size

An idea of the size of the locomotives required to meet present day conditions can be obtained by reference to Tables IV to VIII inclusive, where important orders for the leading types are grouped according to weight. Similar information for the 2-8-2, 2-8-0 and 2-10-2 types of locomotives ordered in 1922 will be found on page 208 of the April, 1923, issue of the *Railway Mechanical Engineer*.

Of the 2-8-0 type, see Table IV, the 25 ordered by the

TABLE V.—PRINCIPAL ORDERS FOR 2-8-2 LOCOMOTIVES IN 1923

Road	No.	Weight, lb.	Cylinders, in.
Delaware, Lackawanna & Western	10	356,500	28 x 32
Central of New Jersey	10	343,000	27 x 32
Pittsburgh & Lake Erie	10	335,000	28 x 30
Missouri Pacific	40	332,900	27 x 32
Chicago, Rock Island & Pacific	30	332,000	28 x 30
Atchison, Topeka & Santa Fe	30	328,300	27 x 32
Southern Ry.	40	326,000	27 x 32
Lehigh Valley	40	325,000	27 x 32
Elgin, Joliet & Eastern	15	320,400	28 x 30
Louisville & Nashville	10	320,000	27 x 32
Canadian Pacific	20	320,000	25½ x 32
Chicago & Eastern Illinois	10	317,500	28 x 30
Carolina, Clinchfield & Ohio	10	316,000	27 x 30
New York, Chicago & St. Louis	30	308,000	26 x 30
Ann Arbor	5	307,000	27 x 30
Canadian National	8	306,000	26 x 30
Indiana Harbor Belt	20	304,500	25 x 32
Central of Georgia	10	300,500	27 x 30
Grand Trunk Western	10	300,000	26 x 30
Seaboard Air Line	23	300,000	26 x 30
Southern Railway	10	292,500	26 x 30
Louisville & Nashville	20	292,000	26 x 30
Mobile & Ohio	13	290,000	26 x 30
Illinois Central	35	282,700	27 x 30
Atlantic Coast Line	7	280,700	27 x 30

Philadelphia & Reading are exceptionally heavy. They weigh 315,585 lb. and have 27 in. by 32 in. cylinders. Those of the same type ordered by this road in 1922 weighed 285,-000 lb. and had 25-in. by 32-in. cylinders. This is one of the few roads which have adhered to the 2-8-0 type and where conditions favor its use.

Table V includes 466 of the 534 locomotives of the 2-8-2 type ordered in 1923 for railroad service. The balance, with the exception of 10 narrow gage locomotives for the Denver & Rio Grande Western, were scattered among various railroads, none of which ordered as many as five locomotives. Grouped according to weight, this list can be totaled up as follows: Heavy (320,000 lb. or over), 255 locomotives, or 55 per cent; medium (300,000 lb. to 320,000 lb.), 126 locomotives, or 27 per cent, and light (under 300,000 lb.), 85 locomotives, or 18 per cent. While no record for size has been broken and the same roads as in 1922 stand at the head of the column with repeat orders, the locomotives of this type ordered in 1923 were of a greater average weight than in 1922.

Table VI shows only four railroads, but includes all but one locomotive of the 2-10-2 type. The Baltimore & Ohio leads both in number and weight. Those for the Great Northern are also larger than any of the type ordered previous to 1923.

Table VII includes 15 railroads and 186 of the 194 loco-

motives of the 4-6-2 type ordered in 1923. Table VIII includes 10 railroads and 137 of the 140 locomotives of the 4-8-2 type ordered. In the latter group the locomotives ordered by the Delaware, Lackawanna & Western; Florida East Coast and the New York, New Haven & Hartford are intended primarily for hauling fast freight. Of the 4-6-2 type locomotives, 85, or about 50 per cent, weighed 300,000 lb. Of the 4-8-2 type locomotives, 96, or 70 per cent, weighed over 350,000 lb. and only one design, that for the Florida East Coast weighed less than 300,000 lb.

Comments on Designs

The tabulations given have shown much as to the general type and size of locomotives now being purchased by American railroads. For switching service, the demand is about equally divided between the six-wheel and eight-wheel types.

For freight traffic, the 2-8-2 continues to be the general standard with a tendency on many roads to a more extended installation of heavier models. On a few roads, which handle a considerable amount of drag freight, the 2-8-0 type

TABLE VI.—PRINCIPAL ORDERS FOR 2-10-2 LOCOMOTIVES IN 1923

Road	No.	Weight, lb.	Cylinders, in.
Baltimore & Ohio	75	436,660	30 x 32
Great Northern	30	422,340	31 x 32
Southern Pacific	51	397,900	29½x 32
Boston & Maine	10	368,000	29 x 32

in heavy models is still favored. The adoption by the Pennsylvania of the 2-10-0 type for heavy freight service is one of the most striking features in recent locomotive design. A number of trunk lines on which heavy grades are encountered on certain divisions, have placed during the past two years large orders for locomotives of the 2-10-2 type. While many of the roads using this type are in the west, the largest order of 1923 was that of the Baltimore & Ohio for 75 of the heaviest design yet built.

The Mallet type is not as generally favored as formerly. In 1922 there were orders for only 116 articulated locomotives and only four orders of any size. In 1923 the total number fell to 53, all but two of which were for only four

TABLE VII.—PRINCIPAL ORDERS FOR 4-6-2 LOCOMOTIVES IN 1923

Road	No.	Weight, lb.	Cylinders, in.
Missouri Pacific	10	316,600	27 x 28
Pennsylvania	42	308,890	27 x 28
Southern Pacific	14	305,300	25 x 28
Canadian Pacific	16	300,500	25 x 30
Southern Railway	16	299,000	27 x 28
Delaware, Lackawanna & Western	10	297,000	25 x 28
Lehigh Valley	10	283,800	25 x 28
Grand Trunk Western	5	283,000	25 x 28
Atlantic Coast Line	25	278,520	25 x 28
Louisville & Nashville	6	277,000	25 x 28
Mobile & Ohio	5	274,600	25 x 28
Boston & Maine	10	253,000	24 x 28
New York, Chicago & St. Louis	6	252,000	22½x 26
Buffalo, Rochester & Pittsburgh	5	241,200	22½x 28
Louisville, Henderson & St. Louis	6	210,000	22 x 26

roads. None of the roads ordering in 1923 were the same as those which ordered in 1922.

For passenger train service, the 4-6-2 continues to be far the most used type. Many of those ordered exceeded 300,000 lb. in weight. A large number of orders for the 4-8-2 type have been placed during the past two years and the list of roads now using this type includes most of the larger systems and many smaller ones. The 4-8-2 type is not only employed where long and heavy passenger trains have to be hauled in territory where the grades are an important factor, but are finding an increasing field of usefulness, particularly in the east, where a number of roads are using them for handling fast freight traffic. The 4-6-0 type has again been brought into prominence by the Pennsylvania, this road having built 40 of an unusually heavy and modern design for branch lines and places where a much heavier 4-6-2 type was not required. Other important roads, while not ordering new locomotives of this type are remodeling older equipment and adding such features as superheaters, outside valve gear and other devices not applied when the locomotives were built. One striking feature of the locomotive orders for the past two years is the practical disappearance of the 4-4-0 and the 4-4-2 types, which not so many years ago were common standards.

A Glance Forward

Probably the most interesting single event in the motive power field in America is the reintroduction during the past year of the three-cylinder locomotive. This type is not a pioneer development as it was tried out many years ago in England and also in this country. During the past few

TABLE VIII.—PRINCIPAL ORDERS FOR 4-8-2 LOCOMOTIVES IN 1923

Road	No.	Weight, lb.	Cylinders, in.
Denver, Rio Grande Western	10	378,600	28 x 30
Delaware, Lackawanna & Western	5	375,000	28 x 30
Chicago, Rock Island & Pacific	10	369,000	28 x 28
Great Northern	28	365,600	29 x 28
Illinois Central	15	362,500	28 x 28
Southern Pacific	28	351,000	28 x 30
New York, New Haven & Hartford	10	334,000	27 x 30
Central of Georgia	10	319,000	27 x 28
New York, Ontario & Western	6	317,000	27 x 28
Florida East Coast	15	285,000	25 x 28

years several designs of three-cylinder simple engines have been brought out in Great Britain and on the Continent, which are making unusually good records. Two locomotives of this type are now in operation on American roads and from results thus far obtained, it would appear as though they were the forerunners of many others.

While the 50 per cent cut-off locomotive is not a development of the past year, it is worthy of note in this connection because of the large orders for such locomotives given in 1923 by the Pennsylvania in addition to the large order of 1922. It would appear that the same principle was worthy of use in other designs.

No new turbine locomotives have been reported as having been placed in service in 1923, but experiments have been continued with the three types, now being tried out in Europe. One, the Ljungstrom, is reported as having been placed in regular revenue service in Sweden. The makers are building another locomotive for an Argentine railroad and arrangements have been made by one of the leading British locomotive builders to construct a similar engine for test and demonstration on British roads.

The interest in Diesel internal combustion locomotives continues active, but the practical development of this type of motor as a railroad prime mover lies still in the future. However, the thought being given to the subject at the present time, both in Europe and America, indicates that some important developments may take place in the near future.

K. C. S. Starts Apprentice System

AFTER investigating railway apprenticeship systems for a year or more, M. A. Hall, superintendent of machinery of the Kansas City Southern, has started the organization of a modern, up-to-date system on that road. A building specially constructed for use as an apprentice school room has just been opened at the Pittsburg, Kan., shops. It is equipped with all of the necessary apparatus, including drawing tables and stools, cabinets for drawings and drawing boards, tables for models, charts, etc. The regular apprentices will attend the school for two two-hour periods each week on company time. The classes will be arranged in such a way as not to include more than 20 boys, and will be held from eight until ten o'clock in the morning and from one to three o'clock in the afternoon. The school room instruction will include a thorough course in mechanical drawing, shop mathematics and special work

for each of the trades. Text books will not be used, but the courses will be especially developed to suit the peculiar needs of the apprentices, depending upon the craft with which they are affiliated. The school will, however, be provided with a reference library and files of technical and trade papers.

All of the school room equipment will be provided by the railroad company, except for the drawing instruments, which, however, will be purchased by the railway company and sold to the students on easy terms. Helper apprentices will be urged to attend the school on their own time and will be given opportunities to participate in the apprentice activities. It is planned to supplement the school room instruction by providing competent shop apprentice instructors in the various departments. After the work is thoroughly organized at Pittsburg it is planned to extend it to Shreveport and other places where a sufficient number of apprentices are employed. C. Y. Thomas, formerly shop apprentice instructor, and later school room instructor on the Atchison, Topeka & Santa Fe at Argentine, Kan., has been employed to take charge of the apprentice system. Mr. Thomas is a son of Frank Thomas, widely known because of having developed the very successful apprenticeship system on the Santa Fe.

A Comprehensive Plan for Executives' Clubs

An Outline of the Principles Involved and the Methods Followed in the Jester Plan

By Simeon van T. Jester
Superintendent of Trade School, Girard College, Philadelphia, Pa.

THE average industrial executive, closely associated with the actual machinery of production or of transportation, is usually so rigidly meshed into the gears on either side of him that he seldom has either the leisure or the opportunity to get a clear conception of the business as a whole, or to make even a casual study of those economic conditions upon which the prosperity of his own and other industries depend. Even executives who have had the advantages of a technical education very often fail to comprehend the importance of the human and the economic factors that enter into the industrial equation.

Releasing Unused Human Energy

Refinements in the technique of industry will continue to be made, but the greatest advances may be looked for in the development of the human factors in industry. A broad understanding of the economics of industry, a more personal interest in the other fellow, and a keen appreciation of the dependence of each worker upon the efforts of all would set in motion vast resources of unused human energy that would revolutionize our industries.

In addition to these conditions within an industry that limit production there is too often in the mind of the public a lack of appreciation of the real economic service rendered by the company. In most cases this attitude is the result of the failure of the company executives themselves to furnish the public with information of the company's performance.

A new type of industrial club has been developed that is helping to correct these conditions. The plan is briefly the formation of an engineering society within a single organization for the serious consideration of the problems of that particular industry. The plan is thoroughly practical and is producing excellent results on two of the eastern railroads, the success of the plan being due very largely to the special educational method that affords an opportunity for each member to actively participate in the discussions at each meeting. And by the same token, the failure of many foremen's clubs and similar organizations may be attributed directly to the lack of experienced educational supervision.

Membership

Since the co-operation and personal support of the executives of all departments are essential for any permanent gains in better industrial relations and in attaining greater efficiency, it has seemed wise to limit the membership to men having supervisory duties and who are actively engaged in the industry. By this plan the experience, the loyalty and the enthusiasm of the whole management family, from the highest officer to the lowest man having charge of other men, is concentrated upon the problems, within and without, that affect that particular industry. Free, open discussion of company policies may be had and new policies or plans thoroughly explained before they are put into operation. It is possible to give to those officers who are in direct contact with workers, with the public and with the materials and equipment of the industry, a clearer conception of the ideals and vision of the highest executive. By such a meeting of the minds of the supervisory officers of all departments it is possible to eliminate many of the leaks and loose connections that frequently occur somewhere between the executive who plans and the supervisory officer who puts the plan into actual operation.

Selling the Idea

The idea should be sold by an outside man of broad educational and industrial experience, who appreciates the service that such a club will render the men, the management and the public. The highest active executives must be approached first and the plan completely sold to them. This will make it possible to get both the moral and the financial support of the management, and at the same time get the idea across that if the club is to be a success it must be managed by the members and not by the management. Having gained the approval and enlisted the support of the highest executives, the idea should then be sold step by step and group by group down the organization chart until the lowest man eligible to membership has been personally sold.

Selling the idea is vitally important and requires considerable tact, in order that no employee may accuse the management of "putting something over" on them. From first to last the point must be continually stressed that the management is willing to help if the men want the club, but that the management will not become responsible for the club or for its direction. For this reason it is very desirable that an outside man be employed to sell the idea and to organize and direct the club.

The officers of the club should not be executives of such a high rank that it will appear that the management has undue authority in the direction of the club. The members should draft and adopt a constitution and by-laws that will

give dignity, stability and permanence to the club, and at the same time provide authority for its operation.

The Educational Program

The educational program presents an opportunity for bringing to the club gifted speakers on both human and technical questions, and during the year company officials will find it convenient to discuss important questions with the club members. The purely educational topics should be broadly educational and of interest to executives in all departments, and should be presented at intervals of one to two weeks until a series of 10 or 12 talks has been given.

About two hours should be devoted to an educational meeting the first hour to the talk of the evening, the last one to a discussion of the topic. In order that the discussion may be lively and that each member may have an opportunity to express his views the audience should be divided into small groups, 25 men to a group, each group in a separate room. These groups should be composed of men doing similar work so that questions discussed may apply directly to the work of that group.

The advantages of the small discussion group are practically unlimited—more opinions, more suggestions, more wrong ideas made right, more careful thought given to discussions, greater development for each member, greater returns to the company.

The questions used by the discussion groups may be on the talk of the evening or other questions related to the work of the group. It has been found desirable to submit a short list of questions to each group at least one week in advance of the meeting night, so that all members may be in readiness for a profitable discussion. This feature, furnishing an open forum for the frank discussion of all questions, soon develops in members the ability "to talk on their feet" and to express their opinions in a direct, convincing manner. The success of the club will depend in no small way upon the success of this feature.

The Discussion Leader

In planning and supervising the discussions the educational adviser will be rendering his greatest service, and since each group must be guided by a discussion leader the problem of training and directing these leaders will be one of the most important duties, and one that will require the highest teaching ability. The leader, by skillful questioning, will get the opinion of each member of his group and will be in a position to correct any wrong impression that may exist and at the same time give each member the benefit of the experience of all the rest.

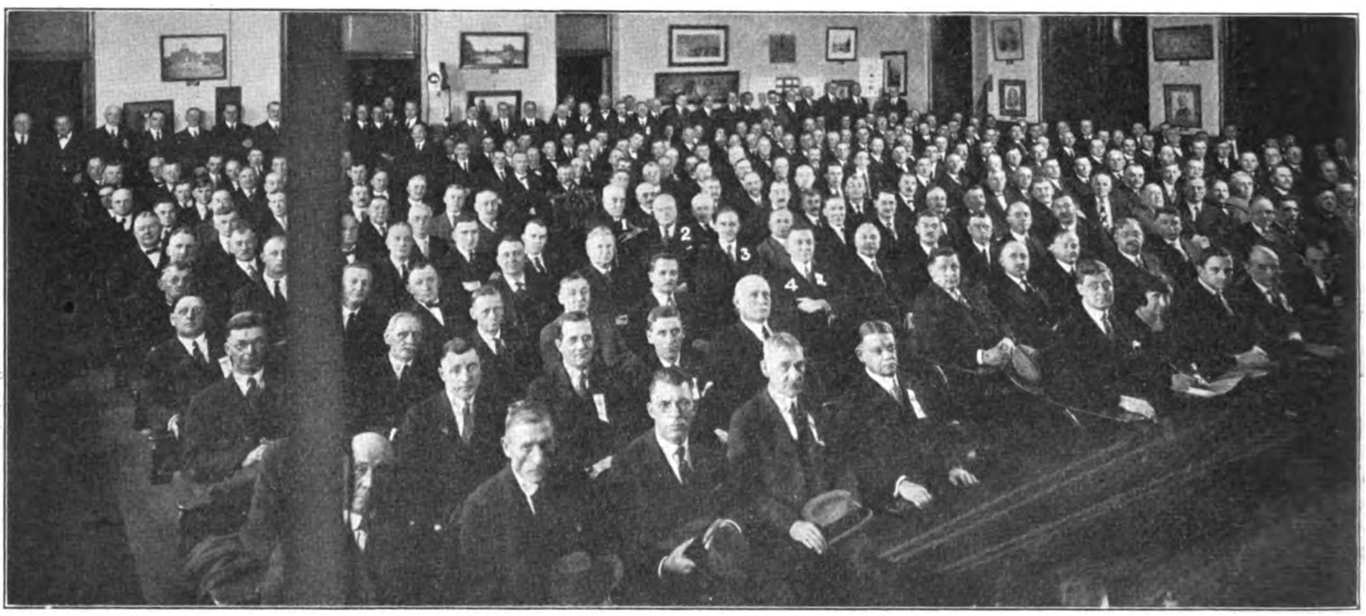
The discussion leader must be a man highly respected by all, and one in whose presence frank discussions will be possible. Above all he must be able to get the opinions of other men, at the same time reserving his own until all have been heard. The autocrat and the boss will fail as a discussion leader. The discussion leader, in directing the thinking of his group, will be occupying one of the most important positions in the club, but along with this additional responsibility will come an unusual opportunity for personal development.

The Company's Attitude

The company must give its support, both financial and otherwise, and have enough confidence in its supervisory officers to keep its hands off and allow the men to run the club. The company should pay one-half the expenses of the educational program and by the willingness of the various higher officials to address the club and by their presence at the meetings should show its genuine interest in the success of the movement.

Advantages

The advantages of such a club to men, to management and to the public are practically unlimited. The educational program along with the small discussion group under the direction of trained leaders enlarges the circle of friends, and breaks down barriers between departments; being limited to the officers of one company it provides a medium for pooling the experiences of all and for developing better methods and policies; it awakens a keen interest in industrial economics, creates a closer bond among the whole management family and affords each member an opportunity to express his opinion on the topics discussed and to get a clearer conception of the ideals and vision of the big men of the organization.



Joint Meeting of Two Philadelphia & Reading Railway Clubs Organized on the Jester Plan. (1) R. H. Aishton, President, American Railway Association. (2) V. B. Fisher, General Superintendent, Philadelphia & Reading Railway. (3) Samuel V. Phillips, President, Shamokin Division Club. (4) J. W. McAdam, President, Reading Club.

The Next Step is the "Thermo-Locomotive"

Application of Diesel Engine to Railroad Work Must Be Undertaken to Meet Present Fuel Problem

By J. Barraja-Frauenfelder

As has been stated before,* the application of the Diesel engine to railroad service is an attractive proposition because the Diesel engine has the highest thermodynamic efficiency of any prime mover developed up to this time. Its fuel consumption per brake horsepower developed is about one-fourth that of a modern superheated steam locomotive and because of the fact that there would be practically no stand-by losses, the Diesel locomotive should use not more than one-fifth as much fuel as a steam locomotive. It also offers attractive possibilities of eliminating water and fuel stops and ash pit expenses and reducing the cost of hauling company coal and other fuel.

The two main problems in the application of the Diesel engine to locomotives are first to obtain a reasonable weight per unit of power and, second, to develop a practical method of starting the train. The Diesel engine, like any internal combustion engine, will not start itself and will not deliver high torque at very low speeds, but will deliver comparatively high torque at reasonably low speeds.

We can well take a leaf off the submarine book and apply its teachings to the locomotive. The problem is somewhat different, but the question of weight is similar. I mention the submarine engine for the further reason that in such an installation not only low weights, but also reliability must be the dominant factors, and these qualities have been obtained in submarines. Few are aware of the fact that the Diesel engine had to be forcibly introduced in the submarine service owing to the fact that the gasoline engine, formerly used up to the decade 1900-1910, was too dangerous. Fumes and leakage of the liquid into such confined and closed quarters as those of a submarine was an ever-present danger resulting in many casualties with consequent loss of life. It became therefore imperative that a safer prime mover be obtained. Economy in operation, while consequential, was not a factor.

The Diesel, then in its infancy, entered the field and conquered. The submarine of today owes its tremendous development to this type of engine, while it unwittingly gave the Diesel its early forcible development in the high-speed, low-weight type and its greatest forward stride.

Submarine engines have been built abroad down to 40, and even 36 lb. per brake horsepower, although the writer would not recommend these for locomotives at present. The weight of additional equipment necessary to produce starting torque would increase this weight appreciably. It cannot for this reason be taken as a criterion of what can be done.

The writer has had personal experience with engines of 50 to 80 lb. per brake horsepower, all eminently suited to locomotive service. The heaviest of these with the necessary attachments for starting under load would probably reach about 100 lb. per brake horsepower, and this would in my opinion be a reasonable weight to start experimenting with and would probably eliminate worries from the weight end when so many other details must be attended to. Prospective revision downward could be undertaken as development progressed. This would quite likely keep the weight of the whole locomotive within the weight at present obtained in steam and electric locomotives, with a factor of weight on drivers to tractive force between four and five.

A revision in weight downward would, in the opinion of the writer, reach a minimum in relation to the rail adhesion required, before constructional limitations of the engine proper would manifest themselves. It is probable that the first cost of Diesel locomotives will be a greater obstacle to their development that either the weight of the engine or other features.

The problem of making the Diesel engine develop power when the train is to be started is of the greatest importance, and to this all efforts should be directed. There are several means by which this can be effected, but there are at present only four that have been attempted which come within the realm of practical possibility.

First—"Mechanical"—or by the well known automobile type of gear shift. Internal combustion locomotives, chiefly gasoline engine propelled, have been built for industrial purposes with this method of transmission and are fairly successful as far as they go. There is however a limitation as to the power which can be handled by this method and it would be absolutely out of the question in large size units, say above 250 brake horsepower. Combination railway motor cars have also been built with gear transmission and gasoline engines which are running with a fair degree of satisfaction in places where no other method of operation would prove successful, but these are by no means as economical as the Diesel engine in fuel consumption. Notable examples of small Diesel locomotives with gear transmission are those built by Benz & Cie.

Second—"Hydraulic"—or by means of a constant speed pump actuated by the engine, pumping and delivering a fluid, usually oil or glycerine, to a variable speed pump functioning as a motor and applied directly or through gears to the driv-

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*See *Railway Mechanical Engineer*, March, 1923, page 156.

ing axles. To this class belongs the "Waterbury Gear" or "Janney-Williams" transmission which has been successfully applied to switching locomotives and which offers any number of intermediate speed points from rest to full speed with correspondingly inversely varying torque, the latter being at maximum at the lowest speed. It is a method of transmission ideally suited to railroad work, but unfortunately it does not appear to be practical beyond about 250 horsepower per unit. Combining at the most four units per locomotive, this would give a maximum of 1,000 horsepower delivered at the axles.

Another transmission of this type is the "Lentz" gear developed in Germany and which has been used, it is said successfully, in connection with Diesel engines up to 350 horsepower by the Linke-Hoffman-Lauchammer Werke Co., of Breslau. This gear, however, unlike the "Waterbury" has only three or four intermediate speed steps between rest and full speed.

Third—"Electric"—wherein the Diesel engine is directly coupled to a generator which in turn furnishes current to motors mounted on the axles. D.C. current is used which permits the employment of a storage battery for starting. Such installations have received so far the widest application owing to the convenience and reliability they offer. A number of railway power coaches are now running successfully in different parts of Europe, specially in Sweden, in powers up to 250 horsepower. The most notable application has been made by Sulzer Bros. of Switzerland. This method is more costly than the others and involves additional weight, which while it can be neglected in small installations, would render its application prohibitive in large units.

Fourth—"Compressed Air"—This consists in using the starting air to a greater extent and to obtain starting torque under load as well as starting the engine under no load. Since starting air must be employed in all the other methods except the electric, this involves an extension of the present method of starting to include the production of sufficient power at start and at low speeds to get the train under way until ignition can be obtained. It is the most direct method and offers the best possibilities for large units and therefore deserves the greatest effort in its development.

It is not an untried field, as a 1,000 horsepower locomotive has been built on this system and has operated successfully in Switzerland and Germany, developing 1,600 brake horsepower at maximum overload conditions and producing ample torque for starting purposes. It is by no means a perfect machine, being rather complicated, but it is susceptible of improvement and simplification. I refer to the Sulzer "Thermo-Locomotive," the most noteworthy example of this class and large enough to prove that this method is practicable in large units.

Other applications of this type have been made, for instance the "Leroux" motor car where an opposed piston engine is used, but the scavenging pump cylinders are made to act as motors when starting. This is merely a different application of the same principle, as air pressure must be used as in the Sulzer machine. Other applications have been suggested and designed, such as the "Burn" Diesel-Air Locomotive.

This class of transmission, or to be correct, direct application of the Diesel engine to a locomotive, is the only one which so far appears worthy of development, and if the Sulzer "Thermo-Locomotive" is a criterion, it is appropriate to describe the main features of the installation and bring out the lesson which it gives us to profit by.

The Sulzer Thermo-Locomotive

This locomotive was designed by Sulzer Bros., I believe at the suggestion of Dr. Diesel and for the German Central Railway Administration in Berlin. Dr. Diesel's death and the war followed the construction and interrupted the trials which up to that time were encouraging. The Diesel engine has progressed enormously since then and it is doubtful whether Sulzers, were they to build another locomotive today, would adopt the same design.

A description of the Sulzer locomotive will be found in the July and August, 1923, numbers of Oil Engine Power. It is a fairly complete description illustrated by sketches and diagrams including indicator cards at various load conditions and accompanied by various data which, while not complete, will permit us to analyze the working cycle fairly close. The indicator cards are small, but if enlarged about ten times will yield sufficient information to reconstruct the thermic cycle with good approximation, thus proving that the conditions obtained are easily within the realm of possibility.

The general characteristics and data of the machine are as follows:

Type of engine:
  Two cycle, four cylinder, trunk piston.
Size of engine:
  Bore, 380 mm., 14 31/32 in.
  Stroke, 550 mm., 21 21/32 in.
  Ratio, stroke, bore, 1 to 45.
  R.P.M., 304.
  Piston speed, 1,085 ft. p. min.
  B.Hp. at 304 r.p.m., and 90 lb. m.e.p. 1,000.
  B.Hp. at 304 r.p.m., and 177 lb. m.e.p. 1,600.
Speed of locomotive at 304 r.p.m., 63 m.p.h.
Speed of locomotive at point of ignition about 6½ m.p.h., corresponding to about 32 r.p.m. or 1/10 of maximum r.p.m.

From the above data it is found that the i.hp. at 177 lb. per sq. in. is 2,065, corresponding to .775 mechanical efficiency, which is not bad for a two-cycle engine with all auxiliaries attached as is the case.

A digest of the description and an examination of the indicator cards discloses the fact that the high m.i.p. obtained were due principally to the so-called "Supercharging Process" whereby more air is forced into the cylinder as more is needed for combustion in accordance with the greater amount of fuel injected to enlarge the card and obtain more power. The volume of the cylinder being constant, it is evident that more air can only be supplied at higher pressure.

This is not an untried process, as the double acting 12,000 b.hp., M.A.N. engine built in Germany before the war, obtained its high power in relation to cylinder displacement by the use of a small supercharge, or up to 8.5 lb. per sq. in., which is obviously too high for pure scavenging, at which rate roughly 25 per cent more power than at atmospheric charging can be obtained, the mechanical efficiency of the whole losing only about two or three per cent.

Again Dr. Riehm of the M.A.N. Company, Augsburg, states that "Better prospects are opened by the method of precompressing (supercharging) the air drawn in, by means of which greater quantity of air is admitted to the working cylinder. Combustion takes place *approximately between the same limits of temperature and pressure as with the normal engines.* The previously compressed air is supplied by a blower. Tests have shown that an increase of output of 30 or 50 per cent can be obtained by this process without a considerable increase of the specific consumption of fuel. Heat stresses in the walls increase only to a small extent."

The limit reached by the Sulzer engine is 21 lb. per sq. in. gage or 35.7 lb. abs., and at this rate 60 per cent more net power was obtained. At this charging pressure the largest indicator card giving 177 lb. per sq. in. m.i.p. was taken. This card considerably enlarged and carefully studied (see chart) discloses several interesting conditions.

The final compression pressure appears to be above 630 lb. per sq. in. gage, not very high, considering that the compression stroke started at 21 lb. gage. At this point a temperature of 1,100 deg. F. might be obtained if the compression curve is adiabatic, but it appears to be of somewhat lower exponent, hence the compression temperature would probably be slightly lower. The corresponding ignition pres-

sure shows at 680 lb., and the temperature is possibly 3,100 deg. F. at this point, but very likely slightly lower. An approximate curve of temperature is plotted on the chart, and shows that the temperatures at any one point of the cycle are well within limits reached in practice.

It is not known what the exact exhaust valve timing was at this load condition. Judging from the card the exhaust opened at about 60 deg. from the bottom center, at this point the pressure would be about 115 lb. gage and the temperature might be as high as 1,700 deg. F., while the valve diagram in the text shows the opening of the exhaust of about 45 deg. from the bottom center. At this point pressures and temperatures are considerably lower but unlikely, hence a logical assumption is that they were somewhere between these two points, and that the diagram shows the timing of the exhaust valve when the starting air only is in use.

Such exhaust pressures and temperatures are to be expected, with such high supercharges, and will probably bring about some interesting problems in cooling and lubrication, but the heat carried off need not be wasted and probably would not in a machine designed today, as an exhaust turbine could be inserted in the circuit to utilize this heat and help produce the supercharge which would be quite a gain in general efficiency. This turbine could be of commercial type, as the temperature could be stepped down from the engine to the nozzle chest to about 850 deg., and thus approximate the conditions found in modern superheated steam turbines.

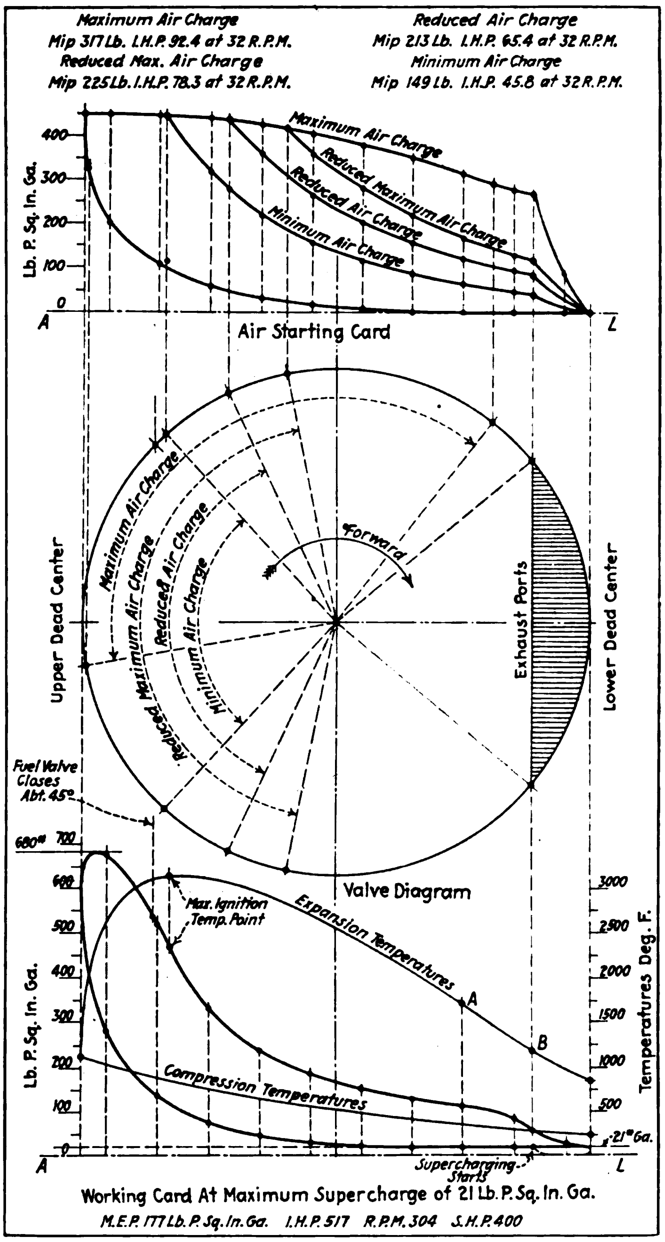
The initial compression pressure can be approximated by assuming an arbitrary final compression pressure with 21 lb. supercharge of 630 lb. gage, the corresponding volume ratio at .125, whence the corresponding conditions at no supercharge would result as 260 lb. gage compression and 750 deg. F. temperature which are very low quantities, in fact it is hardly possible that ignition could have been obtained in this condition with a cold engine, and as smaller compression ratios, sufficient to obtain ignition at no supercharge would have resulted in considerably higher compression pressures and temperatures, which the indicator card by the way does not show, it is logical to assume that the compression ratio could not have been much smaller and that it was probably found more advantageous to run normally at a slight supercharge rate, say 3.5 to 5 lb. gage in order to obtain sufficient heat for ignition rather than run the final overload compression higher than the present day accepted limits for stresses within the cylinder walls.

The fact that Sulzer Bros. use a slight supercharge in their ordinary commercial engines lends color to the above assumption, and due to the special service that the locomotive is required to perform, it is fair to assume that higher supercharging rates are justified, as they would represent various overload conditions to meet grade and other requirements of various duration but shorter than the continuous normal running rate. In fact the particularly exacting requirements of a locomotive would make a flexible supercharging ability advantageous, inasmuch as with a recalcitrant ignition the rate can be increased until ignition is obtained and can subsequently be reduced to normal again after the engine has warmed up.

The diagram while showing a decidedly fat card with resultant high output of the engine also proves that the conditions of overload pressures and temperatures are within the limits of accepted practice.

A further extension of the supercharging process over and above the limits reached by Sulzer would subject the metal to far greater stresses than at present reached, involving more complicated problems in cooling and lubrication, and it is obvious that Sulzer must have found the limit of practicability in their particular engine at 21 lb. gage. Since engines vary, it might be possible to minimize the heat problems in those better able to utilize the useful and dispose of the waste heat such as an opposed piston type is, as represented by such makes as the Junkers, Doxford, Cammellaird-Fullagar and similar types.

Summarizing the above considerations, it is evident that the scavenging process in this type of two-cycle engine is accompanied by a supercharging process which can be varied at will. This process is used to meet sudden demands of increased power to overcome grades, or produce acceleration after starting by air and switching to fuel. This can only be accomplished with such an arrangement of exhaust and scavenging valve motion that the exhaust valve is opened a



Diagrams of 1,000 Hp. Sulzer Thermo-Locomotive

little ahead of the scavenging valve which in turn would perform the double function of first admitting scavenging air at comparatively low pressure to avoid turbulent mixing with the burned gases and subsequently opening wide to let the pressure build up after the exhaust valve has closed to supercharge to any desired rate previous to the beginning of the compression stroke. This involves a special design of scavenge pump, able to vary the delivery pressure in conjunction with the fuel injection rate. With an attached pump the problem is rather complicated but not impossible of solution, while with an independent pump it is compara-

tively easy. The fundamentals to bear in mind are that of the total air supplied by the pump, about 25 to 30 per cent in volume, will be used for scavenging and will blow out with the exhaust, the balance will be compressed within the cylinder to be used for combustion. This balance should contain from 75 to 100 per cent excess over the amount actually needed for chemical action during combustion.

The starting air valve diagram here illustrated shows that it is possible to admit starting air at sufficiently high pressure to insure high torque for starting purposes, but within the limits of ignition pressures, so that no higher stresses are produced during this phase of operation. In this respect the starting air acts much the same as the steam in the ordinary locomotive cylinder where the cut-off can be varied from a maximum when starting to any point to suit load conditions. This phase does not require any special study, except as to the quantity of air required to start the engine and insure several starts before the air storage flasks must be recharged by the auxiliary air compressor.

Under the condition shown in the diagram and using the standard formula for tractive force for simple engines, using the chest pressure for boiler pressure, letting the factor of .85 stand as a margin against the Diesel locomotive, the calculated tractive force would result at 28,000 lb. taking care of the fact that there are four single acting cyclinders, which would be equivalent to two double acting. This figure is not bad, and if it is considered that the whole locomotive weighs 95 tons, approximately 50 of which are on the drivers, the resultant factor is less than four.

Firing begins in the Sulzer locomotive at about 1/10 of the maximum speed of the engine, or about 32 r.p.m. when cold, corresponding to about 6 ½ m.p.h. When warm, this speed could probably be reduced. This is in accordance with results from practice where in moderately high speed engines about one-tenth of the full rated speed is necessary to obtain ignition. The acceleration of the engine has a great deal to do with the length of time it takes to reach firing speed, but taking the data the writer has collected by actual observations, on fair size steam locomotives, and applying them to the Sulzer with a multiplying factor of three to give the Diesel the greatest burden, it would result in an elapsed time of 55 sec. to reach firing speed, during which period a total number of revolutions of the engine of about 15 would be actually made. This multiplied by the number of cylinders and by the cylinder displacement would give the actual number of cubic feet of compressed air required, or 118 cu. ft. With 450 lb. admission pressure, as per diagram, and about 87, ½ per cent cut-off, the m.i.p. would be 317 lb. This would correspond to about 1,100 cu. ft. at atmospheric pressure.

Supposing that at least ten cold starts should be assured to obtain reliability of operation, this would necessitate about 11,000 cu. ft. of free air. This air would have to be stored at very high pressure to be carried within reasonable limits of space. What this storage pressure should be only experience can tell and as Sulzer does not tell us what they have used we must use our own judgment according to present day practice in such cases. The nearest parallel case we can use for comparison is the submarine boat, where air is stored at 2,500 lb. and higher with perfect safety, not a single case of damage or accident from this source having been recorded, in fact this stored energy has been the salvation of many submarines in distress. This 11,000 cu. ft. of free air would go into 220 cu. ft. at 2,500 lb. pressure which is not beyond practical limits. Using this quantity as a factor based on the normal rating of the engine, it results in 0.22 cu. ft. per hp. at 2,500 lb. gage.

The Sulzer locomotive has an auxiliary Diesel driven compressor set of 250 b.hp., which from the drawing appears to be constructed so as to supply the supercharging air above normal from its L. P. cylinder, and delivering this to the H. P. cylinder for recompression to a higher pressure for starting or injection when not in use for supercharging. This seems a convenient and economical arrangement although it involves some complications in compressor design, but such an installation could supply the required air for starting, stored in appropriate steel flasks at 2,500 lb. in about two hours or slightly over, if starting with empty flasks. But since the regular compressor attached to the engine and serving for injection can be designed with a slight excess capacity to be used continuously in recharging the ignition and starting air flasks, and since the auxiliary compressor can be kept running at full or reduced capacity if necessary whenever it is found that the air supply is getting low, this type of installation should not cause any particular apprehension.

Application

All the above functions and events can occur in any two- or four-cycle engine and in some to a greater degree of simplicity, specially in engines of the two-cycle opposed piston, port controlled types. The scavenging period is much more effective in this type and the heat losses are smaller, besides this type will give more power per cylinder and per unit of weight, and can be best adapted to locomotive operation. The Sulzer locomotive engine is actuated by the ordinary type of poppet valves hence more complicated in operation than the opposed piston type. All that has been accomplished in the Sulzer engine can be accomplished in a more modern port operated engine and better. I have not gone into the description of the Sulzer engine at length because of its advantages or because it is an example to follow, but merely because it is a pioneer effort worthy of commendation and if so much was done when the Diesel was not as developed as it is today, much more can be accomplished at the present time by avoiding the development errors made in the Sulzer locomotive.

The scavenging and supercharging action must be necessarily divided in two periods, the scavenging period proper, beginning slightly after the exhaust ports have opened and the supercharging period beginning when the exhaust ports have closed and lasting long enough to build up the pressure within the cylinder to the desired amount but not too long to appreciably cut down the length of the compression stroke. This can be accomplished with scavenge ports longer than the exhaust ports on the in-stroke side, and controlled by a suitable valve so that the excess length of the scavenging over the exhaust ports can be kept blocked during the out-stroke and open during the in-stroke. This is not a difficult method of operation and is extensively used now although not for the the same purpose.

Selection of Type

Having reviewed the practical limits of the operating cycle it remains to settle the principal mechanical features for the selection of the type of construction best adapted to this class of work. The main considerations to begin with are those of space and weight. The lightest and least bulky engines are the high-speed ones, but these must be geared to the driving axles, as their speed is not in harmony with the slower moving driving wheels. This is an objection specially in large units and these interest us most. Then again high-speed engines of the ordinary type are best constructed with vertical cylinders and this conflicts with the height available above the rails. For this reason the opposed piston engine is best adapted to the work, as more power can be obtained out of one cylinder than in the ordinary type and therefore it is possible to run them a little slower to coincide with the speed wanted at the driving wheels without making them too large or too heavy, and by reason of their axial length they can be placed horizontally and connected directly to the driving axles through connecting rods.

It would seem therefore that the problem presents a logical division of types, vertical and horizontal. The latter can be built with a long stroke and installed as described which is the logical position, leaving ample room in the cab for all auxiliaries. This arrangement can be adopted for typical locomotives of all classes from 500 hp. up. The high-speed vertical type can be used for self propelled passenger and merchandise cars, connected to the axles by means of worm gearing as far as this type of transmission will go in the matter of power, and using electric transmission beyond this limit and without supercharge. The vertical type, however, can be built with or without supercharging arrangement as the demand may warrant.

Auxiliaries

1. *Variable Air Pump*—The most important auxiliary is the scavenge pump, now under the double role of scavenger and supercharger if the engine selected is a two-cycle; supercharger only if the engine is a four-cycle. As we are advocating the two-cycle engine for railroad work, we need not concern ourselves with the four-cycle engine in the present instance. The role of scavenger is the minor of the two in point of volume, as the amount of air blown out in the scavening process is only about 25 to 30 per cent of the total volume of free air handled by the pump. We may now give this pump a better name and call it simply a "Variable air pump," since the volume of air it will have to handle will vary with the degree of supercharge desired. But since the volume of air at delivery must remain the same, it follows that only the initial volume of free air will vary. This variation will oscillate between 1.5 to 2.0 times the volume wanted at no supercharge down to any point in between.

If the pump is of the reciprocating type and attached to the engine it would have to be constructed single acting with variable stroke. The variation in stroke can be obtained with a modification of the Stevenson link motion, which in itself is simple but adds moving parts to the engine. If the pump is made independent the variation in volume and pressure can most easily be accomplished with a turbo-blower by varying the speed. This, while absorbing a little more power, is the most satisfactory method, permitting the variation of the blower speed independent of the engine which would be an advantage in starting the locomotive.

The scavenging and supercharging process offers many possibilities which can be enumerated as follows:

1. Attached pump with variable stroke.
2. Completely detached pump, Diesel driven.
3. Completely detached turbo-blower.
4. Attached normal scavenging pump delivering air up to 10 lb. gage, and Diesel driven booster for higher supercharges.
5. Attached normal scavenge pump as above, but supplemented by an exhaust gas driven turbo-booster.

In working up a specific case of a projected locomotive, all the above methods could be figured out carefully to determine which one would be better suited to the conditions to be met.

2. *Air Compressor*—Second in importance is the air compressor, which must perform the duty of supplying air compressed to a suitable pressure into steel flasks for use in starting the locomotive. If we assume the storage pressure to be 2,500 lb. per sq. in., and assuming that the air stored should be sufficient for ten cold starts, then the compressor capacity should be of not less than .225 cu. ft. delivered at the above pressure per actual b.hp. of the main engine. It would have to be a three stage machine, independently driven by a small Diesel engine. It would be advisable to split the capacity into two units on the assumption that one smaller unit only could make up the air used in ordinary service, bringing into play the second unit in case of emergency. Air compressors of such characteristics are obtainable, being produced by several firms for the U. S. Navy for torpedo work.

3. *Water Circulating Pump*—The water circulating pump need not be different from that used in ordinary commercial service except that it would have slightly greater capacity to dispose of a greater amount of heat as the high supercharges would develop. The water service must be supplemented by a suitable cooler preferably of the radiator type.

4. *Lubricating Pumps*—No important change from standard practice is necessary in this auxiliary. The engine being properly designed, no unforeseen lubricating problems should arise as far as the main reciprocating elements are concerned, with the possible exception of the cylinder lubrication, where the longer periods of high heat may demand more careful attention to the oil distribution. Appropriate coolers and filters for this service must also be provided.

5. *Miscellaneous Auxiliaries*—(a) Mufflers.—These will require careful attention in their design, due to the high exhaust pressures and temperatures.

(b) Air brake arrangements are simplified as plenty of air at high pressure is available and can be reduced to the desired pressure for this service.

(c) Heating arrangements will be simplified as the waste heat either from the exhaust or the circulating water can be utilized to produce hot water for heating the train. When the circulating water is used, the heating system will act as a cooler thus reducing the duty of the cooler proper, the exhaust heat can then be used to raise the temperature of the circulating water after it leaves the engine, thus eliminating further radiation losses as would be the case with an exhaust heated boiler.

(d) Lighting arrangements present no special difficulties.

(e) Whistle or syren can be operated by compressed air.

(f) Cooling arrangements for the circulating water can be developed along the same lines as automobile radiators and present no special difficulties.

(g) Fuel sufficient for at least 500 miles can be stored in the locomotive cab without resorting to a tender. This range is beyond the present day practice covering single runs by one locomotive or one crew, being in excess of ten hours.

(h) All the minor auxiliaries of the steam locomotive are eliminated, such as superheaters, feedwater heaters, feed pumps, injectors, stokers, boosters, etc., which while replaced by others in a Diesel locomotive are in greater number than in the latter.

General Constructional Considerations

Outside of the suggestions relative to the type of construction previously made, the following considerations are worthy of note:

1. In general the engine proper would mark a slight departure from the present accepted types on account of the special air pump and different working cycle. For this reason the name of "Thermo-Locomotive" is more fitting than "Diesel-Locomotive."

2. The scavenging process must be specially controlled and of easy manipulation.

3. The supercharging control must be intertwined with the fuel control, so that the operator can vary both at will without having to abandon his station.

4. The fuel control must be made flexible so that the amount of advance and cut-off can be varied within wide limits.

Conclusion

This discussion even if considered in the nature of an academic study demonstrates that the Diesel engine locomotive is not an idle dream nor an impossibility, in fact is far more practical than it is generally supposed. The time is near at hand when fuel and other contributing economical factors will demand a show down and in such event the pioneer, the one with the nerve to lead the way, will reap the benefits. It is hoped that this brief review will arouse sufficient interest to stimulate further discussion of the subject.

Apprentice Makes Constructive Suggestions

Comments Also on Advantages of Some of the Latest Developments of Santa Fe Apprentice Course

Second Prize*

By Harrison Lee Price
Apprentice, Atchison, Topeka & Santa Fe, Ft. Madison, Iowa

THE mechanical department, more than any other department of the railroad, needs trained, loyal employees and supervisors. From a well organized, efficient apprentice department, such as exists on the Santa Fe, a supply of such men is always available. The confidence which the company places in the results of its training methods is evidenced by the number of graduate apprentices now filling supervisory positions. That this confidence is not misplaced is proved by the efficiency maintained in the departments employing a preponderance of graduate apprentices.

With all due respect to this splendid organization, however, there are some practices which I have labeled with a question mark and some suggestions for improvements which might be embodied in "my apprentice department."

First Impressions of New Apprentice

I would start the training of the apprentice with several hours of good heart-to-heart advice from some member of the apprentice board or some instructor properly qualified to deal with such subjects as the safety movement, shop rules and practices, loyalty and its rewards, and the benefit of applying oneself to and taking a real interest in the trade. The object of this talk would be to leave with the apprentice impressions, which if properly followed up by the instructors, ought to be a material aid in getting him into the proper kind of shop habits and practices during that trying period—the first few weeks—when everything is new to and tends to distract the beginner.

Harrison Lee Price

Should the boy start in the machine shop or in the erecting shop and roundhouse? For several very good reasons it appears to me that the proper order of events is to receive the machine and bench experience first. By starting on the machine first he learns what is the proper fit for bolts, pins and bushings; how much drive to allow, etc.; whereas, if he had started on the floor work first, he would sooner or later come in contact with a certain class of mechanics, whose sole idea is to get by as easily as possible, and receive from them an assortment of distorted ideas, which would certainly influence his training. He would have seen these accept a loose bolt or send a properly fitted one back for a little more filing because it was in a difficult location to drive and might call for a little extra exertion if driven with a proper fit, accompanied with some such remark, "No one will ever know the difference after the nuts are tightened." Or a bushing will be sent back to be turned or bored some more, when some labor on a bar, pinching or prying some part of the machinery into alinement, would have answered the same purpose with the result that the machinery would have functioned far better.

The lad who started on the floor would not be equipped by training to ward off such practices and might himself fall into this habit without realizing his error. Then, when he does come to his machine work he will be prone to allow "just a little more on this fit" to make absolutely sure the bushing will go on the pin. Even though he now knows that it is wrong practice, the temptation is too great and he is in a class with the poor mechanics.

On the other hand, the boy who started on the machines knows how to distinguish between the right and wrong and demands that his machine work be up to the standard, or he will not accept it. Then, too, in machining the various parts, he becomes acquainted with the nomenclature of the locomotive and more or less familiar with the general location of the parts. Now when he finally comes to the erecting shop, he very soon connects up his knowledge and much sooner than the fellow who started on the floor work acquires a pretty good working idea of the construction and location, with the relation to their interrelated parts, of the various components of the locomotive. He, therefore, has the advantage of being able to give his undivided attention to the problem of the moment and general erecting shop practices. If the boy is put to work with a mechanic, which is unavoidable if only a beginner, he is liable to be the "goat" of another bad shop practice. That is, the mechanic has a tendency to make of him a low-paid helper, which is a rank injustice to the boy. At best this can only be minimized and then only by a careful selection of the machinist and by the closest and constant observation on the part of the apprentice instructor.

*This article was awarded the second prize in the competition for regular apprentices which closed September 1, 1923. Prize awards were announced in the *Railway Mechanical Engineer* for December, 1923. The first prize article will be found in the January, 1924, issue, page 11.

The School Room Work

Then there is the problem of school. There is no questioning the benefit to be derived from the technical training of the school room, but the apprentice, like every other boy, has, as a rule, a natural distaste for the confinement of the school room, more especially when the school is held after working hours. The Santa Fe allows pay for school hours but does not allow credit on agreement for it. Consequently some further inducement to attend school should be made in an effort to avoid the use of the drastic measures sometimes resorted to. And this is my solution. Every fellow looks forward to his graduation with more or less anticipation. Building around that, in which he evidently takes interest and pleasure, should produce results. In short, give him credit on agreement for hours in school, even if necessary to increase the total hours on indenture. This method would not permit the apprentice to complete his time any faster than the present system, but would delay his graduation to the extent that he cut school.

Give Apprentice Responsibility

A plan now in the experimental stage on the Santa Fe, which offers many exceptional opportunities for the wide-awake apprentice and at the same time rounds out, or completes his shop training, is to give the apprentice charge of a gang to overhaul a locomotive in the back shop for general or heavy repairs. He is, of course, watched pretty closely to avoid any costly errors, but the responsibility for the locomotive is put up to the apprentice. Some of the things which highly commend the plan are: (1) It tends to bring out the amount and quality of his executive ability, and how well he keeps a cool, level head under the obstacles which every day confront the foreman in a locomotive shop. (2) He will take a great deal of pride in "his engine" and, desiring every part to be right, he will realize now if never before, the value of accuracy. (3) Not wishing to delay the locomotive, when due out of shop, he grasps the necessity for speed, which coupled with the aforesaid accuracy, is efficiency. (4) That the company sees fit to trust him with this responsibility, raises it in his esteem, and this is akin to loyalty. Thus the apprentice, himself, fosters the three great requisites of an ideal employee: Accuracy, efficiency and loyalty. For the individual, no better time could be chosen for the enactment of the plan. He is equipped by nearly four years training to undertake the responsibility, and in only a few weeks he will be a journeyman mechanic, when he will have need to remember the lessons recently brought so forcibly to his attention.

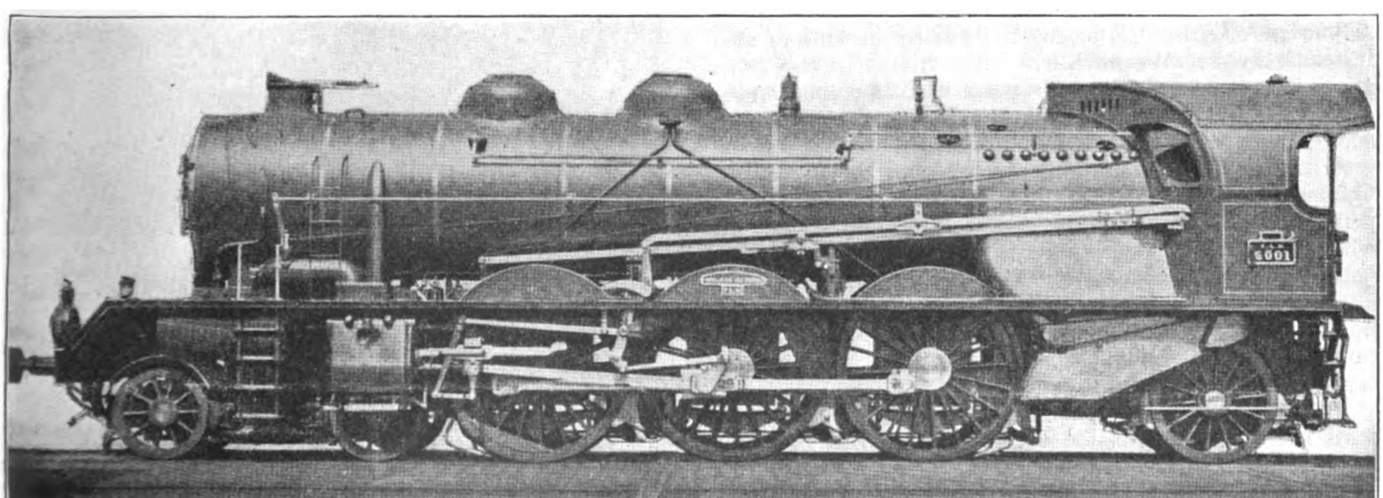
Apprentice Board

What appeals to me as being a big step in the advancement of apprenticeship methods is the establishment of the apprentice board. When an instructor has a number of apprentices under his supervision, a few will naturally be slighted of his attention. Consequently it will fall to the lot of the gang foreman to watch over some apprentices. The apprentice board, composed of certain supervisory officers, and all foremen having apprentices working for them, meets each month to discuss the progress of apprentices. In this way first-hand information is obtained on each boy and this, of course, determines his future handling. This information, which goes into the official records, cannot be other than unbiased, and is therefore a dependable gage of the boy's progress in the shop. Whereas, under a one-man system (shop instructor), prejudice and partiality are bound to creep into the reports. As a mechanic's record, while an apprentice, may often be the deciding factor of his promotion, one realizes the value of trustworthy records.

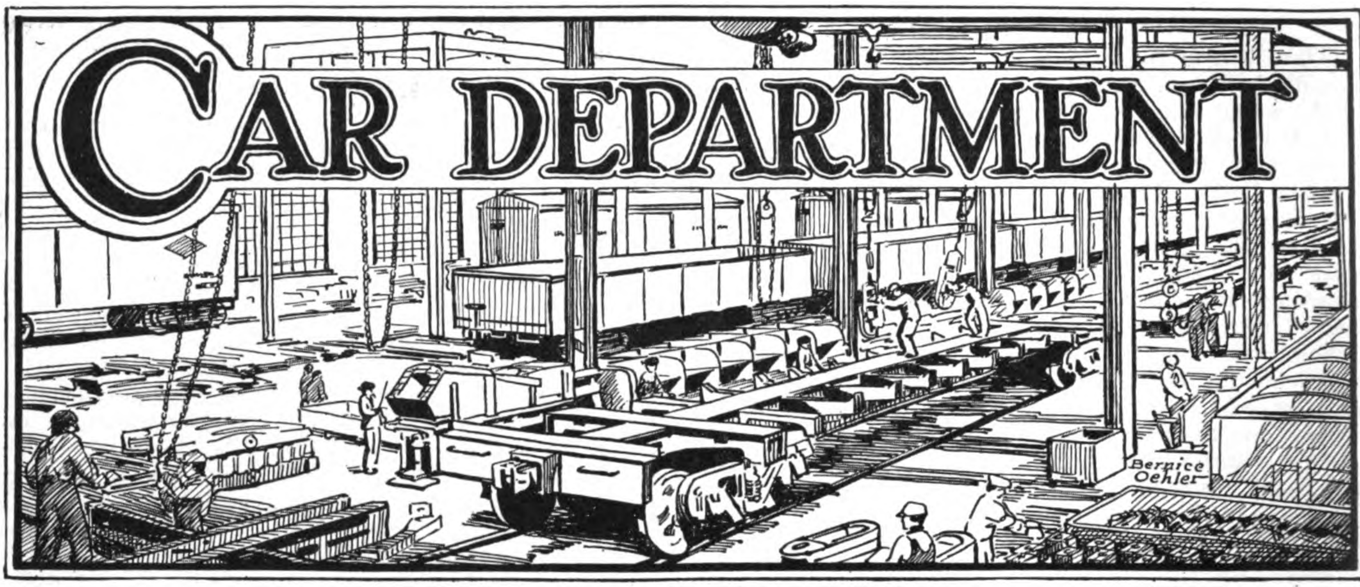
At the age when a boy is serving an apprenticeship, his mind is more susceptible to an impression and more capable of retaining that impression than at any other time. What is shown and taught to the average boy at this time, will remain with him. Therefore, too much care cannot be taken in the selection of the instructor who will teach the apprentices, for upon him depends to a large extent whether the boy be graduated a good, bad or indifferent mechanic. Too often the instructor criticizes the mistakes and poor work and has no praise for work well and faithfully performed. Just as every one expects censure for his mistakes, so should he be encouraged occasionally with a few words of well-placed, deserved praise.

It has been my experience that the instructor (usually a graduate of the Santa Fe apprentice school) is chosen for his more than average mechanical ability and unswerving loyalty. Consequently, when even full paid men look to him for advice why should I not listen to his instructions and have full confidence in what he says and does?

To make a success of this department it has been the policy of the men who fostered it to give full value on investment. From this policy might be derived a "high point" for us apprentices—that the benefit to be derived from an apprenticeship will be proportionate to the effort (or investment) put into it.



A French Pacific Type Locomotive Which Developed One Indicated Horsepower for Each 86 lb. of Weight



Welding and Cutting in Freight Yard Repairs*

Parts That May Be Needed, Procedure to Be Followed, Precautions That Should Be Taken—Scope for Cutting

By H. W. L. Porth
Master Car Builder, Swift Refrigerator Company, Chicago

FOR convenience of presenting this subject, it will be divided into two parts: First, welding in connection with car repairs; second, cutting in connection with car repairs, including cutting of parts preparatory to welding.

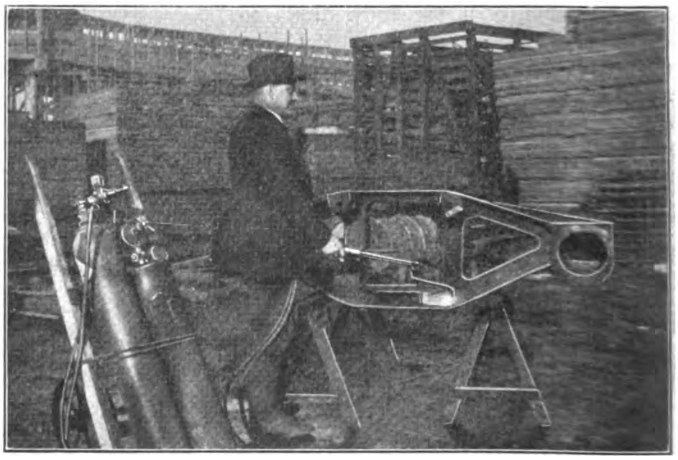
The welding of railroad car parts is controlled by the Committee on Welding of the American Railroad Association, Mechanical Division, who, several years ago, made a thorough investigation of such welding. In 1919, this committee found it "necessary to confine autogenous welding within specified limits on structures subject to alternating stresses and prescribe definite instructions to govern such welding." The penalty for not conforming to the rules prescribed and included in the rules governing the interchange of cars, is that cars cannot be interchanged.

Limitations of A. R. A. Rules

The use of either gas or electricity is permissible in making such welds. We have had little success in the use of arc welding generally on car parts and, for the purpose of this discussion, we are only considering the welding of such parts by the oxy-acetylene process.

According to the limitations as prescribed by the Welding Committee of the A. R. A., the welding of fractures is not permissible on the following parts: Axles, arch bars, car wheels, grab irons, sill steps, truck equalizers, spring or bolster hangers, brake staffs, brake wheels, coupler bodies, knuckles, kunckle pins, locks, lifters and throwers, tanks of tank cars, any parts that are made of alloy or heat treated carbon steel and the top chord angles of open-top all-steel cars only under certain conditions.

The building up of worn surfaces is permissible on car parts subject to compression only, such as spring or bolster hangers, holes in levers, center plates, truck sides, bolsters, column castings and journal boxes. In the case of spring or bolster hangers and holes in levers, the material remaining in the part must be equal to at least 80 per cent of the original section. In the items of center plates, truck sides, bolsters, column castings and journal boxes, the material remaining in the part must be equal to 60 per cent of the original section. The building up of worn surfaces is also permissible on coupler bodies, knuckles, locks, lifters and throwers.



Welding a Cast Steel Truck Side

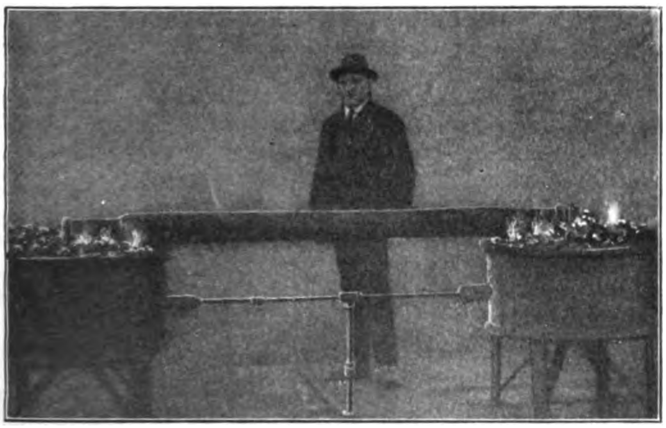
The welding of fractures or cracks is permissible on car and roof sheets, cast steel truck sides, pressed and structural steel truck sides, bolsters and transoms, cast steel bolsters, draft castings, brake beams, cast steel coupler yokes, car sills, posts, braces, stakes, carlines, side plates and end plates, and other car parts subject to compression only and those not sub-

*A paper read before the International Acetylene Association, Chicago, November 14, 1923.

ject to high tension, except as otherwise prohibited. The regulations do not permit of the welding of these parts unless removed from car or truck, except truck transoms, car and roof sheets, draft castings, car sills, posts, braces, stakes, carlines, side plates and end plates. On the items of cast steel truck sides, pressed and structural steel truck sides, bolsters and transoms, cast steel bolsters, brake beams and cast steel coupler yokes, welding is permitted only when the area of the fracture is less than 40 per cent of the total area through the section at the point of fracture. Welding of a fracture is not permissible when located within 6 in. of an old weld.

These rules also provide for the conditions under which the welding must be done, the preparation for welding, the method of making welds, the reinforcing of the welds at fractured points, the annealing and the stamping of welds made for identification purposes. This information includes the date of the weld, the railroad making the weld, the shop where the work is done and the welder's identification mark.

These rules are somewhat strict in limiting the parts that it is permissible to weld. This, doubtless, was a result of the reaction against welding some few years ago, brought about by the exceptional amount of filling up of cracks and fractures with the welding rod and the lack of consideration



Double Forge for Preheating Axles Preliminary to Building Up Collars

for the conditions under which the weld was made or the stresses to which the parts might be subjected in service. This might be termed in railroad welding "the era of poor welding." It was the period during which welding came into wide use and was grossly misused because of the lack of proper control and a proper knowledge of the processes.

Necessity for Welding

There are three reasons for the welding of car parts: First, parts breaking or fracturing, including parts of wrought steel, cast steel and malleable iron; second, parts worn beyond safe or operating limits, including parts of wrought steel, cast steel and malleable iron; third, manufacturing of car parts of wrought steel.

The welding or building up of malleable iron parts cannot be considered good practice under any circumstances. It is sometimes necessary to weld such malleable parts, using bronze welding rod, to overcome critical situations, but under no circumstances can such practice be recommended.

Conditions Under Which Welding Must Be Performed

In some cases welding is done in place on the car and under certain conditions it might be considered good practice. The welding of parts in place, however, should be limited to those that are subjected to compression only—which are rather few when properly analyzed—or parts that can be completely relieved of stress while the welding is being done. Such parts include: Steel body bolsters, striking castings, side frames, draft castings, wrought iron draft members and corner plates. However, the welding of parts in place must be properly controlled by having the conditions right and the welding must be limited in extent.

The welding of all these parts is best handled when the parts are removed from the car and the work is done in the shop. When parts are removed from a car it is then possible to pre-heat them and attain the advantage of slow cooling in the shop, thereby annealing the welded job and saving both labor and gas in making the welds. It is also possible to arrange the part being welded to a position that will permit of the best welding, whereas, if the work is done on the car the welder must handle the job the best he can.

Characteristics That Must Be Attained

The following characteristics are vitally essential in the welding of broken and fractured parts where machinery is not necessary. First, high ductility. Car parts are subjected to alternating stresses in service; therefore, only poor results can be expected from welding where this characteristic is low. Second, high tensile strength. The part probably was fractured because of a porous casting stressed beyond the elastic limit or because of fatigue. It is, therefore, good practice to increase the cross section at the fractured point by building up the area to a greater cross section than in the original part, thus reducing the unit stress for the same applied loading. Third, high elastic limit. The welded material, particularly at the weld and within the affected zone, should be as elastic as possible to recover from the applied stresses. This is especially important when the welded part is of rolled steel.

During the era of poor welding, to which I have previously referred, we were having a lot of trouble from poor welding. We would weld parts and put them on a car, only to find that they were cracked—oftentimes before the car had even gotten out of the shop. It was at that time that we discovered the necessity of properly controlling the characteristics that must be attained in the welding of such parts. In doing this, we have eliminated all difficulties attached to our previous experience.

On building up worn parts the principal desirable characteristic is low hardness—especially where machining is necessary—and absence of slag inclusions in the weld which seriously affects machine tools. On other parts, hardness is somewhat desirable where it is only necessary to grind the part to a contour or gage, thereby permitting of longer life.

Caliber of Workmen

It is absolutely necessary to have good workmen if good work is to be expected. They must be men who understand what they are doing and interested enough in their work to do it in the best possible manner. They also must understand the limitations of the different welding processes as they are obliged to determine at times whether it is good practice to do a welded job or not.

We have had our best success by training our own men under proper supervision and by checking up our several plants at which welding of car parts is done, by periodical visits on the part of the men supervising this work.

I believe that under the present regulations of the A. R. A., Mechanical Division, considering the development of the art during the past three or four years, welding is somewhat hampered, and that with the proper control of the process its scope will be considerably enlarged.

Welding Cast Steel Truck Sides

As the average weight of these castings is about 500 lb., wall cranes are provided for placing the casting in such welding positions as will permit the easiest performance of the work. These castings as removed from cars are usually extremely rusty, and it is necessary to remove the rust and

scale before the welding of cracks in the flanges can be undertaken. Ordinarily no pre-heating or annealing is done.

Welding Truck Bolsters

These castings weigh from 600 to 800 lb. Failures are usually cracks in the top part of the casting. Many times it is necessary to cut a groove across the entire top flange of the bolster before welding is started. The part is pre-heated at the point to be repaired, and after welding is completed it is re-heated and allowed to cool slowly to attain the maximum annealing effect.

Welding Spacing Castings, Draft Arms and Coupler Yokes

These are moderate weight steel castings, weighing around 200 lb. It is the usual practice to heat these castings preparatory to welding but not to make any considerable effort to anneal.

Welding Axles

The standard railroad car axle has a collar at each extreme end, which when new is from 5/8 in. to 7/8 in. thick, depending upon the capacity of the axle. This part of the axle is subjected to considerable end wear. Many times axles are defective merely for this reason, and it is possible to build up the collars sufficiently to allow machining a full thickness collar on the axle. This is done by pre-heating the axle in a forge built to heat both ends of the axle at the same time. Two welders work on an axle, one on each end, the axle being rotated in rolls as the welding progresses. It is necessary in building up axles to keep the slag inclusions at the very minimum to prevent excessive tool wear when machining.

Welding Spring Planks

This part sometimes is made of pressed steel and sometimes of a structural shape. These parts become defective

A Special "Z" Type Tip Is Used on Coupler Work

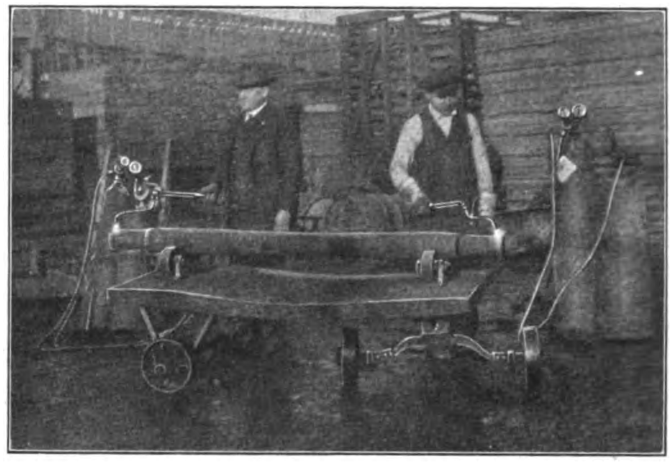
from fractures in the flanges or at the edges. No pre-heating or annealing is done. The point of fracture is thoroughly cleaned and welded from both sides. At one time we attempted to weld these parts when they had entirely broken but had to discontinue the practice because of many failures. The part is subjected to considerable torsional stress. Because of the low ductility in the weld and the zone adjacent to the weld, the stresses set up in the parts in service soon caused them to fail.

The wire used by us in the welding of cast and wrought steel parts has the following chemical characteristics:

Carbon	.04	per cent Maximum
Manganese	.15	per cent Maximum
Phosphorous	.025	per cent Maximum
Sulphur	.03	per cent Maximum

The development of apparatus has become, in some cases, necessary to permit of welding; for instance, in the case of welding fractures in a coupler face. This, although not permissible under the A. R. A., Mechanical Division, rules, has been successfully accomplished by welding such fractures inside and outside. In order to weld inside, it was necessary to develop a special "Z" type tip that would permit the tip to enter the opening for the lock lift. This tip has been indispensable also in the welding of heavy sections of large pieces, where, with the ordinary tip, it would be ruined in a very short time because of the intense heat in close quarters.

We use the electric arc process in welding some parts. This is done where merely building up is the desired re-



Truck Fitted with Rollers for Use in Building Up Axle Collars

pair, and we have found that the oxy-acetylene process is by far the better in general welding, because, with this process, it is possible to obtain the characteristics that are necessary and which have previously been outlined.

Cutting in Connection with Car Repairs

The use of a cutting torch on the repair track has been widely extended in the past few years. It is used for the cutting of parts preparatory to welding with great success, in place of cutting out such grooves with a chipping hammer or a grinding wheel.

We have tried all three practices and have found that cutting with the torch is preferable, as no additional equipment is required, the equipment is always ready for use in the welding shop and greater speed can be attained.

The cutting of rivets, bolts and nuts is handled much easier and possibly no more expensively than cutting with a cold-cut chipping hammer or rivet-buster and with less deformation on the parts cut. This is especially true in the cutting of rivets where the re-riveting of the parts is to be done. The rivets can be cut off with the cutting torch and backed out with little, if any, deformation of the steel parts.

Another wide cutting use is in cutting holes for either rivets or bolts in car parts in place. Instead of drilling with an air drill and "old man" or ratchet drill a hole can easily be put in any steel part where necessary. The holes so cut, according to good practice, should be smaller than the rivet size so as to permit of reaming after cutting with the torch. Again, the rigging up for reaming is much simpler than rigging up for drilling.

For general cutting purposes, we have found the use of hydrogen, as a fuel gas, to be very successful.

The caliber of workmen in cutting is not so vital as in welding. We have been successful in employing apprentices for handling all cutting work. After they have gotten accustomed to the handling of regulators, torches and apparatus in general, they are then given an opportunity to learn the art of welding.

Freight and Passenger Car Orders in 1923

Orders Large though Less than in 1923; Continued Development in Design and Use of Self-Propelled Cars

THE volume of orders for either freight or passenger train cars placed by railroads in the United States in 1923 was less than in 1922. On the other hand, the orders placed by Canadian railroads were very much larger than in the preceding year. Export orders for any kind of rolling stock were few and unusually small.

Freight Car Orders

The freight cars ordered during 1923 for service in the United States totaled 94,471, or about half as many as in 1922. The orders for Canadian service totaled 8,685 as compared with 746 for the previous year. Only 396 cars were ordered for export against 1,072 in 1922. A summary of the freight car orders for the last nine years is given in Table I.

A large proportion of the orders for freight cars, which were booked during the years 1922 and 1923, were placed in the last few months of 1922 and in the early part of 1923. This serves to account for the fact that the reported production of freight cars for domestic service showed a total of 175,748 cars in 1923 as compared with only 66,289 cars in 1922.

TABLE I—ORDERS FOR FREIGHT CARS SINCE 1915

Year	Domestic	Canadian	Export	Total
1915	109,792	.....	18,222	128,014
1916	170,054	.....	35,314	205,368
1917	79,367	.....	53,191	132,558
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	105,552

Prior to 1918 Canadian orders were included in domestic.

The expenditures for additions and betterments made by United States railroads in 1922 was approximately $440,000,000. For 1923 it is estimated that these expenditures will amount to $1,075,897,940, of which $415,923,534, or 39 per cent, was for freight train cars.

The types of freight cars ordered for service in the United States and Canada are shown in Table II.

Only one order for cars of unusually large capacity was placed during 1923; namely, that of the Virginian for 1,025 gondola cars of 240,000 lb. capacity. Included among the orders for gondola and hopper bottom cars were an additional 12,311, of which the capacity was 140,000 lb. This was about one-fourth of all cars of these types.

TABLE II—TYPES OF FREIGHT CARS ORDERED IN 1923 FOR USE IN UNITED STATES AND CANADA

Type	Number	Per Cent
F—Flat and Logging	5,466	5.3
G—Gondola	18,764	18.2
H—Hopper	22,349	21.7
R—Refrigerator	6,457	6.2
S—Stock and poultry	1,214	1.2
T—Tank	5,112	5.0
V—Ventilated box	....	...
X—Box	41,535	40.3
Ballast and dump	1,030	1.0
Not classified	571	0.5
N—Caboose	658	0.6
Total	103,156	100.

The outstanding freight car development during the past year has been the culmination of effort of the American Railway Association toward the development of standard box car designs, in the report of the Mechanical Division Car Construction Committee at this year's convention. This report submitted proposed standard designs of single-sheathed composite and all-steel box cars. Following failure to secure the necessary two-thirds vote on the first letter ballot to which the designs were submitted, they were again submitted to the members of the Mechanical Division with slight modifications to meet the more important objections developing as a result of the first letter ballot, for their action a second time. The letter ballot closed on January 19 and the results will soon be announced.

Passenger Train Car Orders

Orders placed in 1923 for passenger train cars for service on the railways of the United States totaled 2,291, as compared with a total of 2,382 cars in 1922. Cars ordered for use on Canadian railways totaled 266 in 1923 as compared with only 87 in 1922. Orders received for export during the past two years have been insignificant. A tabulation of the orders placed for passenger train cars during the past eight years is shown in Table III.

An idea as to the expenditures being made for new passenger train equipment can be obtained from a recent report of the Bureau of Railway Economics, in which it is estimated that the expenditures for additions and betterments of passenger train cars during 1923 would amount to approximately $50,000,000.

TABLE III—ORDERS FOR PASSENGER EQUIPMENT CARS SINCE 1916

Year	Domestic	Canadian	Export	Total
1916	2,544	...	109	2,653
1917	1,124	...	43	1,167
1918	109	22	26	157
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,448
1923	2,291	266	28	2,585

Prior to 1918 Canadian orders were included in domestic.

While a large number of cars were ordered and installed during the year, it does not mean that the number of cars available for service has been greatly increased. It means rather the replacement of old equipment and more particularly the substitution of steel for wood equipment. The number of passenger train cars in service, for example, at the end of 1918 was 53,941, and on September 30, 1923, the total was only 54,349. In the first three-quarters of 1923 the installations were 1,858 and the retirements, 1,765.

Information in regard to the types of passenger train cars ordered in 1922 and 1923 will be found in Table IV, which includes all cars for service in the United States and Canada, but omits those for export.

The few outstanding developments in passenger car construction during the past year have had to do, not with the engineering features of the design, but with those features of arrangement and finish which affect the comfort and pleasure of the traveler. The Pullman Company has departed from the conventional type of arrangement of its sleeping car sections by the installation of semi-permanent and permanent headboards, both designed to increase the privacy and comfort of travelers in open-section cars.

A pleasing departure from the conventional standard interior finish, with which most recent passenger equipment has been characterized, was made by the Baltimore & Ohio in the interior of its so-called Colonial dining cars. In these cars the window design includes fan and side lights char-

acteristic of the architecture of the Colonial period, and lighting fixtures in keeping with this treatment have been used.

American architecture holds enough of pleasing effect in line, proportion and ornamentation to provide a wide range of individuality in finishing passenger equipment interiors, particularly those of club and dining cars, in a manner that may add an element of pleasure to travel on American railways that, with a few exceptions, has been lacking in the equipment built during the past 10 or 15 years.

TABLE IV—TYPES OF PASSENGER EQUIPMENT CARS ORDERED FOR USE IN UNITED STATES AND CANADA

	1922	1923
Coach, combination passenger, etc.	1,337	736
Sleeping, parlor, chair, etc.	248	488
Dining	71	76
Baggage, express, mail	486	415
Express refrigerator	270	400
Milk	25	323
Horse	19	16
Private, business, miscellaneous	9	15
Gasoline motor and trailer	Not listed	78
Storage battery motor	3	8
Steam motor	1	2
Total	2,469	2,557

Self-Propelled Cars

During the year 1923, orders were reported by the railroads of the United States and Canada for 69 gasoline motor driven rail cars, 9 trailer cars, 8 storage battery motor cars and 2 steam motor cars. In addition, there were export orders for 22 gasoline rail motor cars, which included 12 for the South Australian Railways, 5 for the National Railways of Mexico and 3 for the Havana Central in Cuba.

Self-propelled cars were ordered by 46 railroads in the United States and by two railroads in Canada. Among the larger roads, which ordered such equipment were the Baltimore & Ohio; Chicago, Burlington & Quincy; Chicago Great Western; Cleveland, Cincinnati, Chicago & St. Louis; Delaware & Hudson; Erie; Great Northern; Lehigh & New England; Lehigh Valley; New York, New Haven & Hartford; Pennsylvania; Philadelphia & Reading, and the Canadian National.

During the past year there has been a noticeable change in the trend of development of motor-driven passenger cars from that which characterized the early installations in the recent reintroduction of this type of equipment. At the outset the motor cars for railroad use were largely confined to adaptations of standard motor truck chassis. Aside from the special body, the use of a light four-wheel leading truck and the application of flanged steel tires, the equipment was very largely built along the lines of standard automobile practice. Although there was a field for this type of equipment, it soon became apparent that it could not meet the conditions imposed in many cases where the railroads were not only willing, but anxious to install self-propelled motor car service.

During the past year the tendency has been largely toward the development of units of greater carrying capacity, equipped with motors sufficiently powerful to maintain steam train schedules with the heavier cars, or when hauling a trailer. This has taken the development out of the strictly motor truck field and has called for considerable pioneering in the development of a satisfactory motor unit and transmission system. The present tendency is toward the use of double-end control, and there are at least three types of control and transmission for which double-end control has been developed. These are the hydraulic transmission, the mechanical transmission of the automobile type with electro-pneumatic control, and the electric transmission and control.

One of the interesting developments of the year is the application of gasoline motors to standard railway coaches, using two motor units per coach. This depended on the successful development of a synchronous electro-pneumatic system of operating the mechanical transmissions of the two motors, one for each truck, which was accomplished by the Oneida Manufacturing Company in its installation on a Chicago & North Western coach.

In general, the tendency is away from the ready-made equipment, conforming largely to automobile standards, and in the direction of conformity to standard railroad practice in a constantly increasing degree in all parts of the equipment except the motor and transmission, which are the subjects of special development for this field.

Considerable attention has been given during the last two years in America as well as in Europe, to the possibilities of the Diesel engine as the prime mover both for self-propelled cars and locomotives. Its high thermal efficiency and the character of the fuel which it uses, makes it highly attractive for both these purposes. Its low torque at slow speeds and the comparatively large amount of energy required to start it, as well as its comparatively limited development in types of sufficiently high speed to bring the weight per horsepower within practicable limits for either service, are conditions which future developments must overcome before dependence can be placed on this type of prime mover for railroad service. In the meantime high-power, high-speed gasoline engines, with the disadvantages of their short life and relatively high maintenance costs, as compared with the smaller sizes used in automobile practice, must still be the mainstay of immediate developments involving the use of internal combustion motors.

Mounting Steel Car Wheels

By W. F. Tidswell

THE fitting of steel wheels on axles differs considerably in detail from that of cast iron wheels; the boring of the wheel is necessarily slower and greater care must be exercised to produce a smooth and parallel bore. Special cutters are used, and finer feeds. The axles are prepared in much the same way as they are for cast iron wheels but the wheel seat, if anything, should be freer from tool marks and perfectly round. The maximum and minimum tonnage at which wheels are pressed on varies with the different railroads according to their particular ideas of safety, and each may be good practice.

As far as I have been able to observe, 11 tons per inch of diameter for minimum pressure and 15 tons per inch of diameter for maximum pressure will give the desired results. There is such a thing as putting the wheels on at too high a pressure; if extremely high pressure is used, the metal in the wheel hub will expand to the elastic limit and take a set, and, in that event, the wheel is not as tight as it would have been if put on at a lower pressure, keeping the stresses under the elastic limit. There is still another reason for not putting wheels on so tight and that is that some day these wheels will have to be pressed off. The removal of wheels from axles that have been in place for a long period is sometimes very difficult, and cutting the hub or plate with acetylene gas to relieve the pressure is necessary before the wheels can be pressed off.

In boring steel car wheels to fit the axle, an allowance of .005 in. to .010 in. is made. This varies according to the carbon content of the wheel; the more carbon the harder the wheel, and consequently the less expansion in the hub.

One factor in fitting both cast iron and steel wheels on axles is sometimes lost sight of, or at least not taken into consideration, and that is weather conditions. In cold, snappy weather where the wheels are exposed more or less, the tonnage will vary considerably from that during mild or hot periods. This fact I have observed many times; in

cold weather the iron or steel does not adjust itself to the pressures as readily as it does in hot weather, it requiring a smaller variation in the size of the axle and wheel to bring the tonnage pressure within the limits than it does when the weather is colder.

Mate Wheels by Carbon Content

Too much care can not be taken in mating wheels according to the carbon contained in the steel, this being of greater importance than the diameter; for if the diameter varies it can be corrected in the wheel lathe, but the carbon is there for the life of the wheel. If a wheel of high carbon be mated with one of low carbon, it is quite obvious that the wear will not be the same. The softer wheel will wear more rapidly than its mate. The wheel will consequently require turning more often thus causing a needless expense, not only on account of the loss of service metal in the harder wheel but the expense incurred by the removal of the wheels from the truck, and subsequent handling.

The wheels referred to in the foregoing apply both to freight and passenger service. Preparing an axle for passenger service, however, is quite different from preparing one for freight service. The wheel seat should be entirely free from tool marks, parallel and round. The journal should be parallel, round and absolutely smooth. The method used to finish the journal differs somewhat in the various shops. A common practice is to roll the journal but this is a method that I believe can be improved upon; a highly polished surface does not necessarily mean that it will give the best service.

When a journal is rolled it rolls down the fiber of the metal more or less according to the surface left by the finishing tool, and if from any cause the journal becomes hot these fine hair-like fibers raise up, and a cut journal is the consequence. To prove this, after a journal is rolled, rub your hand around it the reverse way from that in which it revolved when it was turned and you can feel a roughness similar to that of a man's face after shaving. This of course may not give any trouble, and then again it may, so why take the chance?

There is a way the journal may be finished that will remove this possibility. After turning the journal as smooth as the skill of the workman can make it, place the axle in a speed lathe and with slow, steady strokes file the journal with a medium smooth file until the roughness has been overcome. Then finish the surface with an emery cloth on wooden clamps. This will not produce a highly polished surface, which means nothing, but will remove the fine hair-like fibers that would only be rolled down if finished with a "burnishing roller."

Car Shop Facilities, Equipment and Practices*

Which Will Reduce Out-of-Service Time of Modern Cars and Thereby Increase Railroad Earnings

By H. W. Williams

Special Representative to the General Superintendent of Motive Power, C., M. & St. P., Chicago

THE utilization of cars is the product of their loading and their movement; therefore, the responsibility for the utilization of freight cars may be placed upon three parties: The shipper, the transportation department and mechanical department.

Inasmuch as the shipper is in the position of a customer, he must be treated with courtesy and respect, so we will merely say to him that we will greatly appreciate his endeavor to load and unload our cars promptly; to load them as nearly as possible to capacity and to see that his crane and dumping operators handle the cars without undue roughness.

Within our own organization the responsibility for the utilization of equipment is divided between the transportation and mechanical departments. It is the duty of the transportation department to move the cars and of the mechanical department to keep them in serviceable condition. The problem of securing mileage of cars is that of keeping them moving. In the main, this is a terminal problem, for once the car is in the train it ordinarily proceeds to the next terminal with reasonable promptness. The terminal is built primarily as a means of classifying cars for forwarding, yet it frequently gives the impression that it is used more for storage purposes. Considerable thought and study has been given this problem during the last two or three years with the result that a number of roads have instituted the practice of classifying cars for main track movements over long distances. The adoption of this policy has proved profitable in most cases. The terminal is the crux of the transportation problem for there is a great deal more to be gained here toward increased car mileage than in any other particular place by eliminating congestion and delays.

This phase of the problem is not within the province of the mechanical department and we can do but little more than to mention it as a matter for consideration and recommend it for serious thought and study. We can, however, make it our duty to see that we offer no resistance to the expeditious handling of cars by being prompt with our inspections and light repairs, and by assisting in every way possible to keep revenue cars serviceable and ready for schedule movements.

"Light" and "Heavy" Repairs

Generally speaking, freight train car repairs are divided into two classes: Light and heavy. These are rather indefinite terms, yet they are so familiar as to be readily understood by all.

To a certain extent, the problem of handling light repairs is readily dealt with; that is, given reasonably adequate supplies of tools, material and standard parts, and a certain force of men, that part of the maintenance problem will take care of itself and cars will be switched on and off of the rip track daily without much fluctuation. This does not infer, however, that a large amount of money is not involved in this work, but the point is that very little can be done to improve on the methods and practices now prevalent in performing this class of work. Light repairs consist of work done to offset current wear, breakages and loss of parts accruing from the ordinary handling and movements of cars day by day. No distinction is made between foreign and home cars or between classes or series of cars. All cars are run in together,

*Paper read before the 1923 Car Department Staff Meeting of the Chicago, Milwaukee & St. Paul.

necessary repairs made, and the cars pulled out and put into service again as quickly as possible. Each car is handled individually. No two cars have the same defects nor require the same kind of repairs and for this reason there is very little that can be done to anticipate the necessary repairs except to have a reasonable supply of material and parts on hand to expedite the work.

The situation with respect to heavy car repairs is entirely different. Heavy repairs accrue, generally speaking, from three different sources: Wrecks, ordinary wear and tear as accumulated over a period of years, and obsolescence. Repairs to cars accumulated from the first two sources are usually accomplished by replacements in kind. More extensive work is required to overcome obsolescence as in this case it becomes necessary to strengthen and remodel the cars to overcome inherent weakness in design and construction. It is in the disposal of heavy repairs accumulating from long periods of service and from obsolescence that the greatest opportunities exist for the mechanical department to produce economies and reduce the time that the cars are held out of service.

In general, a freight car requires heavy repairs or rebuilding about once in every eight years. In addition to the deterioration of important parts, it is necessary in these general overhaulings not only to replace these parts, but also to overcome obsolescence in design. On this basis, about 12½ per cent of the freight cars should be rebuilt and brought up to date every year. Such figures as are available indicate that few roads have conformed to this practice in the past, and that, therefore, there is a large amount of deferred maintenance. Many of the older cars are being operated without improvements which should be made if they are to give satisfactory service. The fact that cars are not being rebuilt at the proper intervals, means that the equipment as a whole is not averaging as well as it should in car miles per day or in car days in service. Therefore, is it not the proper thing to anticipate such work as far as possible and prepare for it in advance?

A careful survey should be made of the equipment to determine such series of cars which according to this law or cycle of repairs are due or will be due within a definite time for general overhauling and arrange to call in such cars to designated points for concentrated work. All cars within the series selected should be overhauled whether they are in bad order or not, as experience indicates that if they are not already in bad order, it is only a question of a short time until they will be.

During recent years a large number of heavy repairs or rebuilding programs have been performed for the railroads in contract shops. The outstanding fact with respect to these contracts is that they cover the performance of identical operations of a large number of cars of the same series. This means much in reducing the cost per car to a minimum. New material can be purchased and fabricated in quantities. The fixed facilities can be located and adjusted to best serve the particular operations to be performed and the number and size of gangs can be adjusted to obtain a perfect plan. Special hand tools may be provided to fit the specific requirements of a single series of cars, and the gangs organized for a repetition for certain specialized operation are able to develop a facility of performance entirely impossible when no two consecutive operations are alike.

Contrast this with the usual run of heavy car repairs as handled at the railroad car shop or repair track. Cars are taken into the shop without regard to series, just as they become available by chance arrival at the home shop. Even where some attempt is made to accumulate a run of cars of a single series each car is likely to be subjected to individual treatment based on detailed inspection so that there is considerable variation both in the kind of material and the nature of the work required for the individual cars.

Organize for Repairs to Single Classes of Cars

Is not this, then, the key to the whole situation? If a railroad can call in the cars of a single series in sufficient number to meet the requirements of a contract shop, is it not equally possible to make the same arrangement with respect to the operation of at least part of its own heavy car repair facilities? This might call for the setting aside of a part of a given shop to be organized to handle a single class of cars until that series has all received the needed heavy repairs or a single shop may be devoted entirely to this class of work, leaving the other shops to take care of the current run of miscellaneous heavy repair work. The advantages of thus organizing heavy repairs are so far reaching in their effect on the cost per unit that they should receive careful consideration.

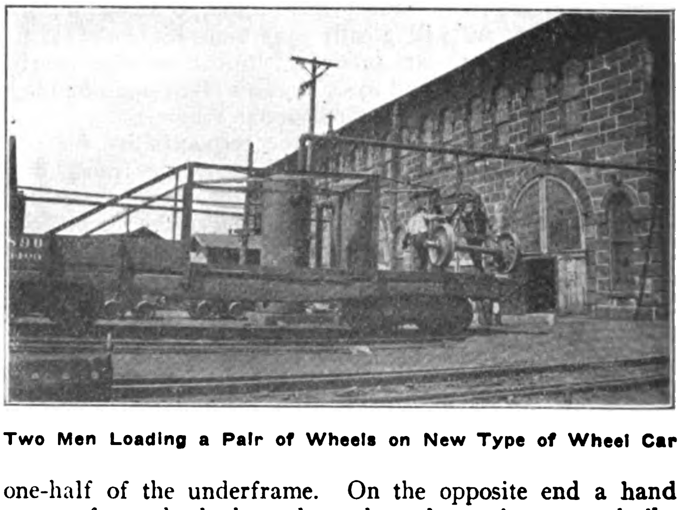
To carry out this policy successfully, it will be necessary to organize carefully. The plans and construction of each series of cars should be studied well in advance of the work and such changes as are necessary to overcome inherent weaknesses in the car itself must be developed beforehand so that materials will be obtained and parts fabricated in advance. Then everything will be in readiness for application when the cars are placed in the shop for repairs. The repair forces should be organized into individual gangs to handle the various phases of the work so that the cars will advance step by step through the shops. With such an organization a high productivity and a rapid turn-over of cars will be obtained. Careful organization along this line will do more than anything else toward decreasing the out-of-service period of modern cars.

A Wheel Car for Changing Wheels on the Line

By W. W. Warner

Works Manager, Youngstown Equipment Company

A CAR has been constructed from an old steel underframe box car for the purpose of reducing to a minimum delays to cars set out for wheels. This car was taken from a series that was being dismantled. It is of 60,000 lb. capacity and 36 ft. long. The superstructure above the floor was removed and plank sides 24 in. high applied to



Two Men Loading a Pair of Wheels on New Type of Wheel Car

one-half of the underframe. On the opposite end a hand crane of standard channels and angle sections was built. Gearing, standard to section hand cars, was used in constructing the operating parts. With this crane, one man is able to load a pair of wheels with 10-in. journals. A box is provided on the end of the car for a pair of jacks, necessary tools, journal box packing, and an assortment of box

and column bolts and nuts. Two pairs of wheels of each size commonly used in freight service, are carried on the car.

As soon as a message is received from the division superintendent that a car requiring wheels has been set out, the special wheel car is placed on the first train and billed to the point where the car requiring the wheels is waiting. The men to do the work are sent either with the special wheel car or on the first passenger train. This procedure is carried out with much less expense than the old method where it was necessary to load a pair of wheels on a flat car or drop end gondola, with the blocking, jacks, and other equipment required to apply the wheels. This car was sent to the point where the wheels were required and the men were sent on the first available train. In many cases the car needing the wheels was located in such a place that it was difficult to get the wheels off the car on which they were shipped and under the car to which they were to be applied. It was usually necessary to roll the wheels out on the ground and then move them with wheel sticks to the desired position.

By the new method the wheel car can be placed on an adjacent track, or on the same track, if possible, next to the end of the car where the wheels are to be applied. Then the wheels can be swung around and lowered to the track ready to roll into place. The old wheels can be picked up with the crane and swung around on to the wheel car. This reduces the amount of work and time required to the minimum. This method also provides for bringing in the old wheels that have been removed instead of leaving them along the right-of-way for several months as was formerly the common practice.

Recent Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will prrint abstracts of decisions as rendered.*)

Air Brakes Cleaned More Than Once Within Sixty Days

The Fort Worth & Denver City rendered a bill, on June 22, 1922, for repairs to 43 cars belonging to the St. Louis Southwestern. This bill included a charge of $248.32 covering repairs made during April and May, 1922, for cleaning, oiling, testing, stencilling and repairing the air brakes. Thirty-two out of the 43 cars had been cleaned within less than eight months from the date of the previous cleaning, and six cars were cleaned twice by the Fort Worth & Denver City within an average of three days between cleanings.

The St. Louis Southwestern claimed that these repairs were not necessary as it had given the matter of cleaning the air brakes on these cars close attention, as was evidenced by the fact that out of the total of 43 cars involved in the argument, only 6 cars were out of date under the rules. It also contended that the charge of $161.23 covering the repairs on the 32 cars was improper and should be cancelled.

The Fort Worth & Denver City stated that at the time the work was done on these cars, the Interstate Commerce Commission inspectors were on its line and were penalizing the road for this defect. This required it to watch all trains closely, and it was also found that in order to comply with the United States Safety Appliance Acts, it was necessary to perform a large amount of such repairs at that time. This made it appear that it was specializing in this class of repairs, but it contended that it was within its rights in cleaning the air brakes on any car as per A. R. A. Rule 60 and that the charges as rendered were proper.

The Arbitration Committee rendered the following decision: Arbitration case 1260* applies. Settlement shall be made accordingly.—*Cake No. 1279, St. Louis-Southwestern vs. Fort Worth & Denver City.*

Duplicate Charge for Repacking Journal Boxes

On August 4, 1920, the Baltimore & Ohio charged the Texas & Pacific for repacking the journal boxes on T. & P. car No. 16142, there being no date showing the time the boxes were last packed, stenciled on the car. The journal boxes were packed again on March 2, 1921, by the Northern Pacific. This road also presented a bill for repacking the journal boxes, reporting the stenciling as showing the old date to be B. & O. March, 1920.

The Texas & Pacific took exceptions to the two charges against this car coming within a period of seven months, claiming that it was not in accordance with A. R. A. Rule 66, which specified that no charge should be made if the repacking is done within nine months from the date stenciled on the car. It contended that either the Baltimore & Ohio or the Northern Pacific should withdraw its charge by furnishing an offset authority.

The Baltimore & Ohio refused to withdraw its charge, claiming that the car was not on its line during March, 1920, and that it stenciled the car August, 1920. The Northern Pacific claimed that it had reported the correct old stenciling and that the Baltimore & Ohio stenciled this car "3-20" instead of "8-20" as indicated by its billing repair card.

It was decided by the Arbitration Committee that, inasmuch as the Baltimore & Ohio states positively that the car was not on its line during March, 1920, it is evident that the Northern Pacific mis-read the stencil marks and its bill, therefore, should be withdrawn.—*Case No. 1278, Texas & Pacific vs. Baltimore & Ohio and Northern Pacific.*

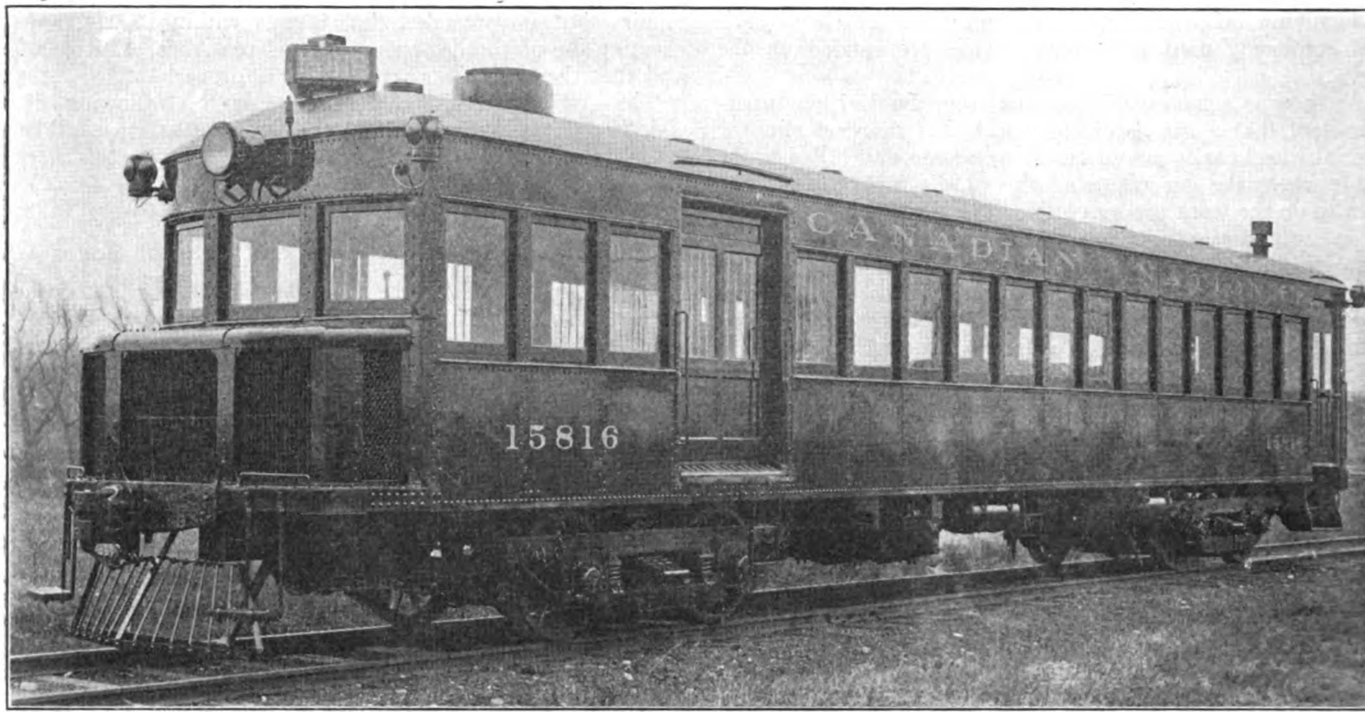
Responsibility for Car Damaged in Switching

St. Louis, Troy & Eastern car No. 1517 was damaged while being switched in the Madison, Mo., yards of the Terminal Railroad Association of St. Louis. It was reported by the yard foreman at Madison yards, that while switching on the south end of the westbound track at 8:10 p. m. October 6, 1921, he noted that there was room on track 36 for five cars. He took the slack on five cars and let them roll in on track 36. The St. Louis, Troy & Eastern empty coal car No. 1517, standing thirteenth from the head end of the train on this track, broke in two. After making an examination, the car was chained up and placed on track 40. This work incurred a delay of 25 min. The damage to the car consisted of two broken center sills, four broken intermediate sills, two broken side sills and eight broken coal side boards. There was no damage done to the track. The Terminal Railroad based its case on this report, which it claimed to be correct. The owner contended that a rider was necessary on these cars in order to control them properly as there is .5 per cent grade at this point. It asked a decision requiring the handling line to pay the cost of repairs, claiming unfair usage.

It was decided by the Arbitration Committee that the damage to this car was the handling line's responsibility, according to Rule 32, Section (d), Item 4. The decision under Case No. 1,224† was referred to.—*Case No. 1,274, St. Louis, Troy & Eastern vs. Terminal Railroad Association of St. Louis.*

*Case No. 1,260 was reviewed in the October, 1923, number of the *Railway Mechanical Engineer.*

†Arbitration Case No. 1224 was reviewed in the September, 1922, number of the *Railway Mechanical Engineer.*



Gasoline Motor Coach Built by the National Steel Car Corporation and Driven by 225-Hp. Sterling Engine

Canadian National Gasoline Motor Car

National Steel Car Corporation Builds Steel Coach Seating 55 Persons, Driven by 225-Hp. Motor

THE Canadian National probably has made a longer and more thorough study of the possibilities of the self-propelled rail motor car than any other railroad. In the endeavor to find out which types were the best suited to the various peculiar traffic conditions existing in different places, a number of cars have been built and tested out. Some have been small and others relatively heavy. The list has included those driven by gasoline passenger car engines, gasoline truck engines, steam engines and electric storage battery motors. The latest addition to the list is a steel-body combined passenger and baggage car built by the National Steel Car Corporation, Hamilton, Ontario, and driven by a 225-hp. Sterling gasoline engine. This car was delivered to the Canadian National in November, 1923, and after thorough tests was placed in regular service between Toronto and Hamilton, a distance of 38.7 miles, where it is at present in operation. The car leaves Hamilton at 6:30 a.m. and arrives at Toronto at 7:35 a.m., and on the return trip, it leaves Toronto at 9:30 p.m., reaching Hamilton at 10:45 p.m. It is reported that even when running at high speed—with the governor set for 50 miles per hour—no noticeable vibration is experienced, oscillation and sidesway are slight and that for smooth and silent running it compares well with standard passenger cars in steam service.

The car is of steel construction with a single arch type roof formed of flat steel bar carlines, and ½-in. poplar roof boards, covered with canvas, well bedded in white lead. The steel underframe includes fish belly type center sills, spaced to provide room for engine and transmission.

The length of the car overall is 55 ft. 9½ in.; the length over end sills, 54 ft. 1½ in.; the width over side sheathing, 8 ft. 9 in.; the height from top of rail to floor, 3 ft. 9⅝ in., and the height from the top of rail to roof, 12 ft. 9 in. The weight of the car is between 40,000 lb. and 45,000 lb.

The interior is divided into two compartments. The rear or passenger compartment is 31 ft. 2 in. long and provided with seats for 44 passengers. The front or baggage compartment is 15 ft. 2 in. long and, while intended primarily for carrying baggage and express, is fitted with collapsible wooden slat seats, which accommodate 11 passengers when occasion requires. On a basis of 55 seated passengers, the dead weight per passenger is between 75 and 80 lb.

The interior of the passenger compartment is finished in cherry with Agasote ceiling, and presents a pleasing appearance. The partition between the two compartments matches the interior finish and is provided with a double-swing door having a plate glass panel. The double, non-reversible transverse seats are upholstered in green plush with polished brass corner grabs on the seat backs. All windows are arranged to raise and are fitted with removable storm sash. The curtains are of silk-faced Pantasote with Rex rollers and Forsythe ring fixtures. A drinking water tank and cup vendor are provided. There is one saloon in the passenger compartment fitted with hopper, folding wash basin, mirror and paper towel holder.

The rear platform has two vestibule side doors and O. M. Edwards steel trap doors, covering the step openings. A vestibule end door is provided for use in case a trailer is carried. The rear body end door is of cherry with glazed panel and swings inward. The vestibule end windows are provided with storm sash and all doors have weather stripping to make the platform weather proof.

The baggage compartment is sheathed with poplar, with open-carline finish. There is a sliding baggage door with 4 ft. opening on each side. All windows are arranged to raise

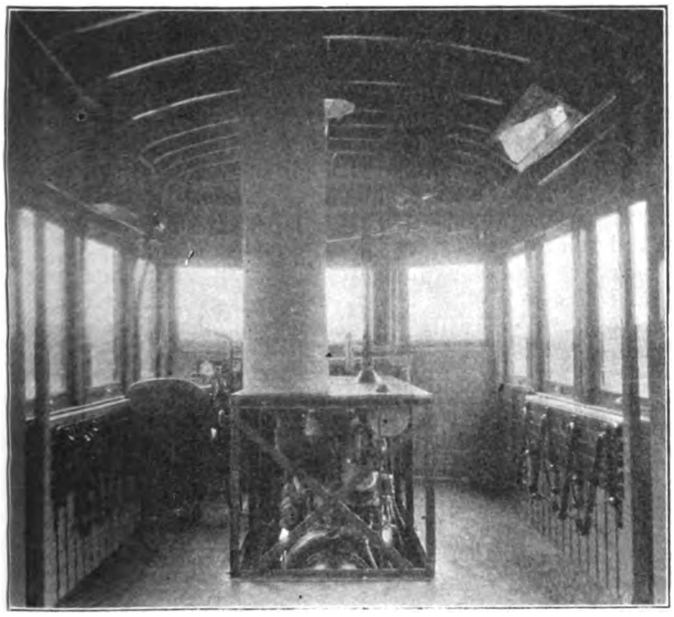
except the two at the driver's seat, which are arranged to drop.

The trucks are of the four-wheel pedestal type, spaced 32 ft. 3 in. from center to center of bolsters, and have a 5-ft. 8-in. wheel base. The wheels are 36 in. in diameter, steel tired, and have spoke type centers. The journal bearings are of the Stafford roller type with roller end thrust. Each truck has two triple elliptic bolster springs and four helical equalizer springs. The bolster is of the swing motion type; the frames are of 6-in. structural steel channels, and the pedestals and equalizer spring caps are of cast steel.

Each end of the car is fitted with a Type D coupler. The front one is supported by a steel casting attached to the end sill in such a manner that it can be taken down easily should occasion arise to remove the engine from the car. The rear coupler is fitted with a spring draft gear.

The car is driven by a Sterling, Dolphin type, six-cylinder gasoline engine, with cylinder of 5¾-in. bore and 6¾-in. stroke. The power rating of the engine is as follows: 800 r.p.m., 116 hp.; 1,000 r.p.m., 144 hp.; 1,200 r.p.m.; 180 hp., 1,400 r.p.m., 205 hp., and 1,600 r.p.m., 225 hp. The engine and clutch are carried on a sub-frame, which is supported from the car center sills by a three-point suspension and so arranged that the entire unit of frame, engine and clutch can be removed through the end of the car by sliding the frame brackets along the center sill bottom angles after the front coupler and radiator have been removed.

The engine is fitted with two Stromberg carburetors and triple ignition furnished by a North East 12-volt generator



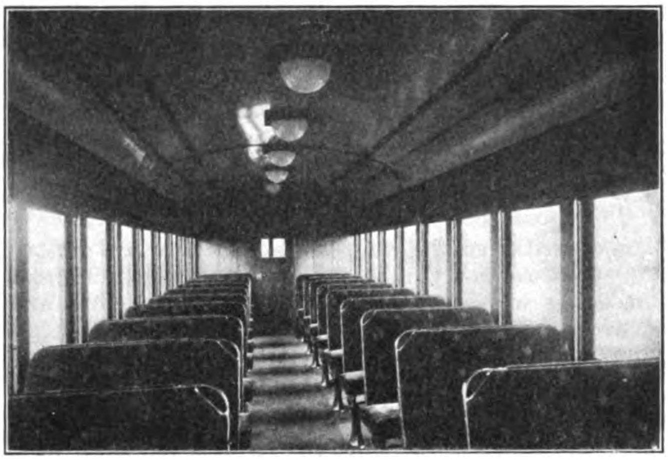
Baggage Compartment, Looking Toward Driver's Seat; Seats Folded Back and Casing Around Motor Removed

in connection with a Westinghouse 6-cell 12-volt storage battery, with an emergency switch to take ignition from the 32-volt lighting batteries. These lighting batteries are also used for the North East starting motor. There are two gasoline tanks having a combined capacity of 75 gallons, which are carried below the car body. The gasoline is pumped from the main tanks to an auxiliary tank from which it feeds by gravity to the carburetors.

The clutch is of the multiple disk type and runs in oil. The transmission is of special design and provides four speeds forward and three speeds in reverse. The gear shift is of the progressive type. The drive is through the trailing axle of the forward truck and the leading axle of the trailing truck, the power being carried from the transmission to the axles by flexible shafts and bevel gearing. The bevel gears are enclosed in a steel housing with a torque arm suspended from equalizer bars mounted on the inside axle. Provision is made for disengaging the front truck drive shaft by an operating lever near the driver's seat, thus permitting driving from the rear truck only in cases where the required tractive force is small.

When the interior view of the front compartment was taken, the sides of the steel casing enclosing the engine were removed. The large asbestos covered sheet metal pipe leading from the top of the engine casing carries the escaping gases of combustion to a short stack extending through the car roof. The emergency passenger seats are folded back against the side walls to provide maximum space for baggage.

A Peter Smith hot water heater is installed in a separate heater room in the passenger compartment, which also contains the coal box. Hot water pipes are lead along both sides



Interior of Passenger Compartment Looking Toward the Rear

of the car under the seats. Change of air is obtained by five ventilators in the car roof, which may be opened and closed from the interior.

Current for lighting is furnished by a U. S. L. Type F generator, with chain drive from the engine and 16-cell, 32-volt U. S. L. batteries underneath the car near the center. The lighting fixtures include seven center-ceiling, 50-watt lamps in the passenger compartment, two in the front compartment and two rear vestibule lamps. An electric headlight and marker lights are also provided.

The brake is of the Westinghouse combined automatic and straight air type, with provision for trailer operation. Air is furnished by a D. H. 10 compressor connected to the transmission by a noiseless chain drive. The brake rigging on the truck is of the clasp type. Air sanding apparatus delivers sand in front of both trucks.

Fuel Recovery from Ashes.—According to a recent issue of Engineering (London) magnetism is now being successfully employed to recover unburned fuel from ashes. The apparatus devised by Messrs. Fried Krupp in Germany depends for its operation upon the fact that practically all coal contains iron in the form of pyrites. Although the pyrites have no magnetic properties, they are converted into magnetic oxides of iron when the coal is burned. As the whole of the iron passes away with the clinker, the metal exists there in a much more concentrated form than in the original coal. The actual separation is accomplished by passing the furnace refuse over a rotating magnetic drum, the ashes being delivered to the drum by a bucket elevator and a vibrating screen. Each size is passed separately to the surface of the drum. The clinkers, on account of the iron contained, are held magnetically to the surface for a portion of the revolution and then drop off into small wagons or other receptacles as the current exciting the portion of the drum that holds them is automatically broken. Particles of good coal and coke, containing no magnetic oxides, do not adhere to the drum, but leave it directly after contact, falling vertically into special hoppers.

Inspection and Maintenance of Freight Cars*

Journal Boxes, Air and Hand Brakes the Most Important Items Either on Repair Track or in Shop

By Emil Erickson
Car Foreman, New York Central, Chicago

IT is desired to get the best possible inspection and get cars in such condition that the transportation department can make the highest speed with trains over the road and also avoid the loading of bad order cars. In order to secure results it must be borne in mind that sufficient time should be allowed on trains and sufficient help to do the necessary work in the proper manner.

Inspection of Cars on Arrival at the Receiving Yard

On arrival of cars in receiving yard, the track must be properly protected by a flag or light, and where work is done that requires men going underneath the cars, the track should be locked for the protection of the men doing this work.

After the track is properly protected, it is well to give the train an air test, to locate any defective brakes. In doing this, you will prevent getting the cars with defective brakes lined up in the outbound train, which often means switching the cars out after the train is made up.

Where the air brake work is taken care of in the classification yard this in-bound air test would not be necessary, as in this case it would not require switching out the car for any air brake defects.

The train should be carefully inspected for any other defective cars that have to go to the repair track. All defects that can be repaired in the train should be marked up "Repair in Train."

Empty cars should be carefully inspected and carded for the class of commodity they are fit to carry. Bad order cars should be carded to repair tracks or shop.

Loaded cars having defects such as should be repaired before reloading, but will permit the car to go to destination, should be carded "Repair Track or Shop When Empty" to avoid reloading before repairs are made. No loaded car should be cut out and sent to the repair track that can be repaired in the train, as this means delay as well as extra expense in handling.

Cars inspected for the loading of powder and other explosives should never be inspected except in daylight as it is impossible to make proper inspection by lamp light and the party making this inspection should be familiar with all instructions covering this class of lading. This also refers to cars for loading flour, grain, merchandise and other ladings that require water-tight roof, sides and ends.

Inspectors should be instructed to give careful attention to running gears, draft gears, and safety appliances. Also to brake hanger pins and cotters, brake beams and hangers, brake hanger bolts and cotters, box bolt and column bolt nuts, arch bars, truck sides and wheels, journal boxes and contained parts, knuckles and knuckle pins.

Loose and worn box bolts and missing oil box covers generally indicate flat or shelled out wheels. Close inspection should be made for wheel defects such as worn or broken flanges, seamy and hollow treads, broken brackets and broken plates.

Defective draft rigging can generally be noticed by broken striking plates, coupler pulled out too far, or coupler horn backed solid against the striking plate.

Defective conditions in journal boxes such as cracked and worn lining and other defects that will eventually cause a hot box can generally be detected by paying particular attention to the end of the journal around the center punch mark, which will invariably show a sign of heating around the center a long time before it actually develops into a hot box. If close attention is given to this sign many hot boxes can be prevented if corrective measures are taken by pulling out the packing and examining the journal bearing and wedge, as well as packing, which often is found to be in bad condition at the rear of box, although apparently all right at the front.

Cars Coming from Connections

In receiving cars from connections inspection should be made for delivering line defects to protect the receiving line against such as are chargeable to the delivering line. However, inspectors should be taught not to be too technical in receiving cars from connections as there is no need under present A. R. A. rules to hold up cars unnecessarily. This refers particularly to loaded cars as it is more important to get loads to destination than to hold cars for a minor defect.

Empty cars offered in interchange on an order for certain classes of lading should be inspected to see that they are fit for such lading, in order to prevent them from being moved from the point of interchange to the loading point and afterwards rejected.

Inspectors should be instructed in keeping proper records as to cars carded "bad order," defects and cause, cars carded for lading, etc.

Reports should be made out for all cars damaged in yard

* Abstract of a paper read before the Car Foremen's Association of Chicago and at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, held at Chicago, October 3-5, 1923.

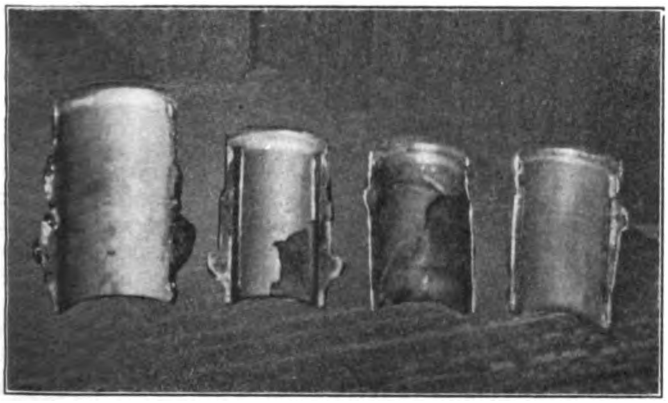
or train service, giving full information as to how the damage occurred.

The necessary information should always be shown on bad order cards as well as damage reports as to how the damage was caused. All records should be checked to see that they conform to A. R. A. rules.

In the receiving yards a great deal of good can be accomplished and considerable delay can be eliminated by having men to do all light running repairs—such as applying brake hangers, brake shoes and keys, brasses, journal box keys, and other light repairs that can be made in the train yard. This saves switching to repair tracks and also delay in getting cars to their destination.

Inspection and Repair of Cars in Classification Yards

After the work has been completed in the receiving yard and trains are made up, the air brake men should give the train the standard brake test, and make inspection for any



Defective Brasses (Left to Right): Cracked Lining; Broken Lining; Worn Lining; Cracked and Pitted

defects that may have developed in yard switching in order to prevent any cars so damaged leaving the terminal.

It may not be possible to make repairs in some receiving yards due to limited room or other operating conditions. In these cases the defects can be taken care of in the classification yard, after the train is made up and turned over to the inspectors by the transportation department. However, in either case sufficient time should be allowed to do the work properly. It is a great deal better to get the train in first class condition before allowing it to leave the terminal than it is to have delays on the division and having to set out cars on the road, which often results in damage claims.

To get trains over the road with a minimum of hot boxes, the best results can be obtained by having the oilers go over the train after it has been made up, as in yard switching packing and brasses are often misplaced due to switching of cars, particularly on empty and light loaded cars. Therefore, by having the oilers go over the train carefully, after it has been built up, they will be able to replace the packing and see that it is in proper condition before leaving the yard. It has been the writer's experience that many waste grabs are discovered in this manner and corrected before the cars get out of the terminal.

Inspection of Cars at Miscellaneous Loading Points

Inspectors at industries and other loading points should be thoroughly familiar with loading rules, and should do all they can to help the shipper in getting the cars loaded in accordance with the rules.

When inspecting a car for a certain class of lading, he should see that it is fit for the class of lading it is going to carry, and that it is in such condition that it will carry the load to desination without being set out en route due to bad order—barring accidents.

Cars set for any lading that may be damaged by protruding nails or bolts should have the protruding nails or bolts removed. A great deal could be accomplished by having all nails and cleats removed when cars are unloaded.

Particular attention should be given the running gear, draft rigging, air and hand brakes before cars are loaded.

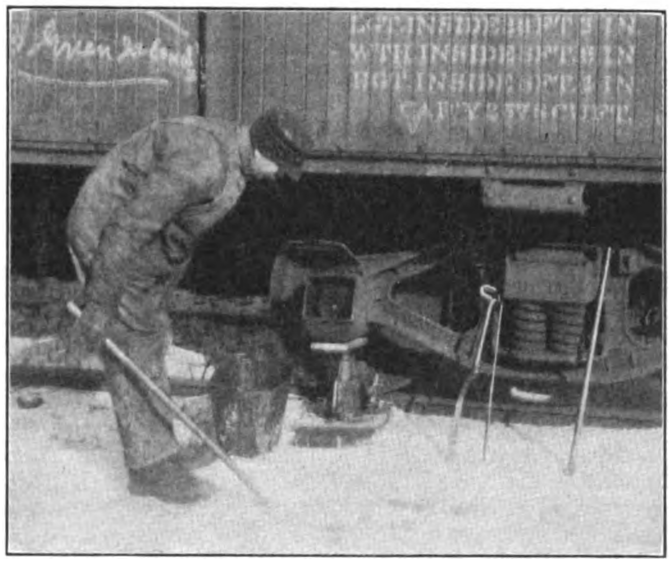
At all loading points a sufficient force should be employed to see that every car is in first class condition before it is allowed to go forward, as at most loading points there is much more time to do the work than in the train yards.

Inspection and Repair of Cars on Repair or Shop Tracks

Loaded cars on repair tracks or shop tracks should be gone over by competent inspectors before repairs are started. All work that is to be done should be written up on the original record repair card. The defects and cause of defects in all cases should be plainly marked or stated. For example, the words "Missing," "Bent" or "Broken" should not be used alone but the condition under which they were missing, broken, or bent must be plainly stated.

All cars on repair tracks should have couplers gaged as to height and also have knuckles gaged to determine any worn part. A satisfactory way of doing this is to assign a man to go over the tracks in the morning to gage couplers, and mark on the ends of the car the coupler height as well as condition of the knuckles. In this way the inspector in writing up the other work can enter this information on his record repair card.

Trucks should be examined as to brake hangers and pins, cotters, and other defects. All journal boxes should be inspected as to the condition of dope, journal bearings and other parts.



Special Jacking Block Hooks Over the Wheel Rim, Holding the Wheel Down While Changing the Brass

On heavily loaded cars particular attention should be paid to side bearing clearness, in fact, no car should be allowed to leave the track without having all necessary repairs given attention in order to keep the car from being set out or placed on the next repair track. Of course, in cases of loaded cars judgment should be used, so as not to cause unnecessary delay for defects that will not prevent the car carrying its load to destination.

Empty cars set for light repairs should be thoroughly inspected and repair work to be done should be written up, as stated above, on the regular original record repair cards. Empty cars undergoing light repairs should always be put in shape for the best class of service possible with light repairs.

At most places and at most times the repair track foreman

and the inspectors have to govern themselves according to the demand for cars. If there is a heavy demand for cars for a certain class of lading he has to see that he gets his cars fixed up for this lading in the least possible time in order to take care of this demand. He should, however, at all times bear in mind that the nearer he gets the car in 100 per cent condition before it leaves his tracks the longer it will stay off the repair tracks.

In handling repairs on repair tracks, as well as at shops, the writer has found that the most important items to take care of are the journal boxes and contents, the air brakes and hand brakes.

I have found the most satisfactory way to get results has been to assign special men to take care of repacking and re-brassing the cars when passing over shop and repair tracks, as well as to assign all the air brake and hand brake work to special men. By assigning special men to these particular duties they get more familiar with the work and produce better results. This, of course, as you know, can be extended to the rest of the repair work as well.

It has been my experience, in regard to taking care of the lubrication of cars passing over the repair tracks, that by assigning a special gang to repack and rebrass the cars these men have become experts in detecting defective brasses and other defects, and I feel that a great deal of our hot box trouble could be eliminated by all railroads making it a practice to follow up the changing of brasses and repacking the boxes the same as we do in the way of cleaning and repairing air brakes—once in every twelve months.

I have, personally, made repeated tests on some of our new cars that have been in service from one to two years and found that invariably on the car that has been in service over 12 months a large percentage of brasses are in defective condition. Some of the common defects are cracked and loose linings; others worn out.

I feel that if this practice were put into effect, hot box trouble would be reduced to a minimum. Our experience on passenger equipment, on which this practice is followed up, has been—and is—that hot boxes are practically eliminated. Of course, on passenger equipment we follow it up much closer than once a year, in fact, in the winter months the cars are jacked and repacked once every three months.

When we consider that practically all freight cars get on some repair track at least once every year, it would not be any more work to take care of the boxes once every year than it is to clean and repair air brakes annually.

One point in regard to the causes of hot boxes, that has been brought up very plainly to the writer, is that almost all start in the rear of the box. When a hot box is discovered before it actually bursts into flame and the packing is pulled out, you will generally find that the packing in the rear of the box is packed in there so hard that it becomes glazed and dry. This condition you will find on cars that have been running for several years without being repacked. This is brought about by continued poking in the box and adding a little more dope in front. This, of course, we all know is through lack of knowledge on the part of the person doing the oiling and repacking in the yards. If every oiler would use the packing iron properly this condition would not exist. Instead of continually pushing the dope back in the box it should be thoroughly loosened up from the front to the back, and packing placed in the box firmly, but not forced in solid enough to cause it to become hard and dry.

As you all know, the power of the air brake is useless unless the foundation brake rigging is properly adjusted and maintained. There is a chance for lots of educational work along the lines of instructing the repairmen in the importance of applying the proper levers, rods and connections when making repairs to the brake rigging.

A K-2 valve is not worth much if the top rod is too long, the bottom rod too short, or a wrong cylinder lever is used. I have found the best way to get cars going off repair tracks with good brakes is to train a certain number of men to be responsible for the condition of the entire brake apparatus on the car, as it is almost impossible to train all of the car repairmen to thoroughly understand the brake rigging all the way from the triple valve to the brake shoe.

One of the most common faults in letting ordinary repairmen connect up the brake rigging, is that when he renews the brake beam he does not pay any attention to the difference in the brake beam fulcrum, which, we know, varies from 1 in. to 3½ in. You will find that the majority will use the same bottom rod and connect it in the same hole as it was when the old beam was on the car, in this way disarranging the entire brake rigging, causing wrong alignment of levers and wrong piston travel.

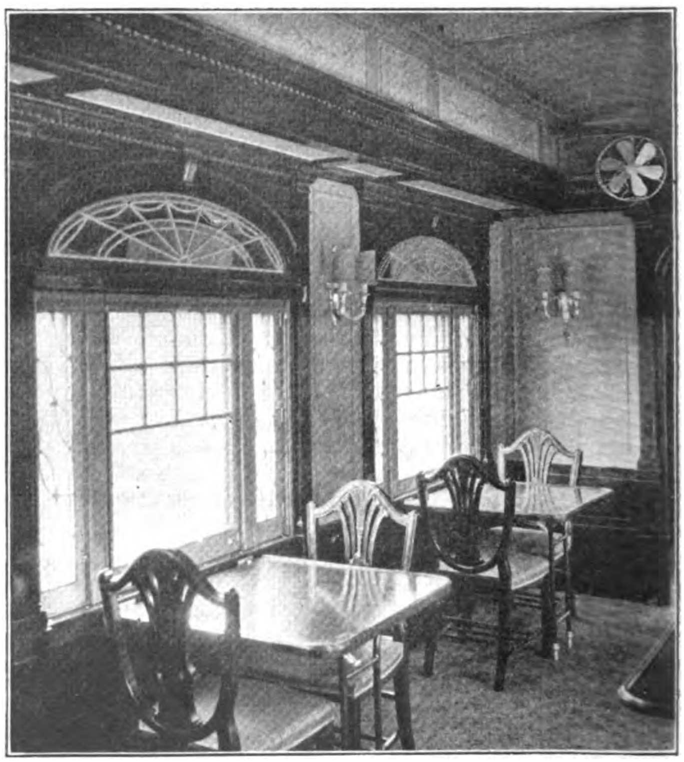
These conditions, of course, are mostly found from the smaller points where there is no air testing out the piston travel, but I will have to admit that I have seen these conditions come from some of the large points.

If a special gang is educated along these lines they soon become acquainted with the different classes of cars that they handle and have little trouble in detecting the faults.

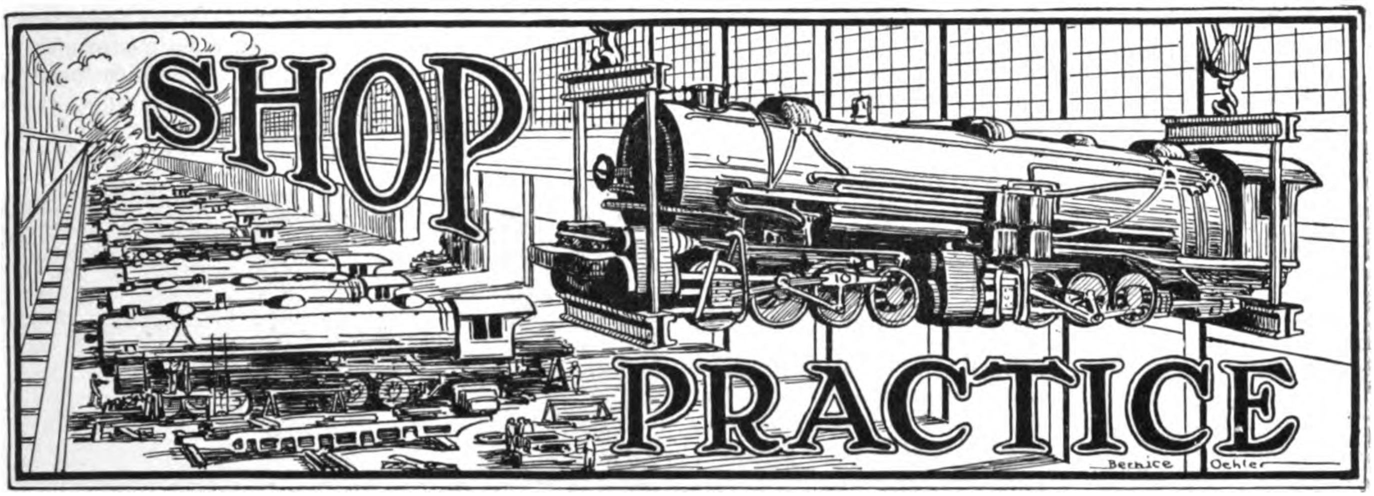
Discussion

T. S. Cheadle (R. F. & P.): I found quite a few cases, lately, where the indication was that a journal was heating and, on jacking the car for examination, I found it had been given attention. I do not know just how to overcome this.

In taking care of the work as much as possible out in the train yards, also the light repair tracks, my experience is that a good deal can be accomplished by furnishing the men with the proper tools to do the work. I mention one tool especially and that is a ratchet pipe wrench. I have known of a car having to be carried from one to six miles to get to a place where a man could thread a pipe—the heavy rip track. The car foreman turns himself into a car mover, instead of a car repairer, and, in trying to keep down the bad orders, he forgets the intention on the repair track is to get the car 100 per cent.



Broad Windows with Side Casements Tone with the Colonial Decorations of New B. & O. Diners

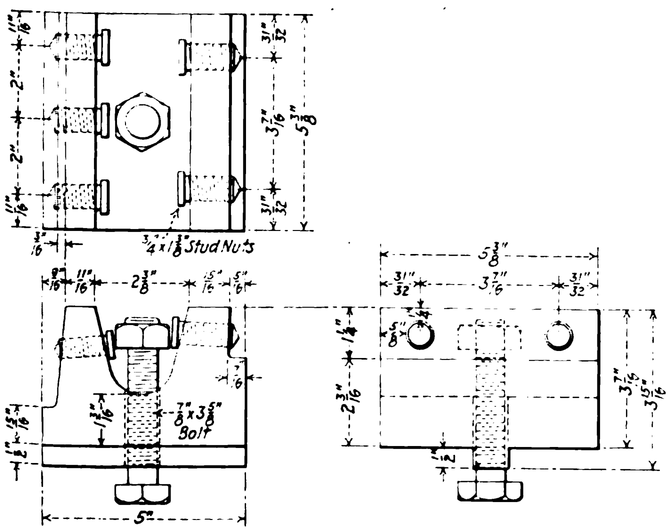


Driving Box Wedge Jig

By H. H. Henson
Southern Railway, Chattanooga, Tenn.

A JIG for securing driving box wedges to the table of a planer is shown in the drawing. Its use permits the completion of the entire operation of planing without removing the wedges. The number of wedges that may be planed at one time is limited only by the size of the planer table.

The jigs are made of machine steel, as shown in the drawing, and are fastened to the planer table by ⅞-in. by 3⅝-in. T-head bolts. One is placed at the end of each wedge, the wide end resting on the lower shelf of one jig and the narrow end resting on the upper shelf of another jig. The wedges are fastened or anchored on the jig, as shown in the illustration, by means of conical shaped ¾-in. by 1⅜-in. set screws, casehardened at the cone end. A row of wedges is clamped in place end to end on the table with a jig between each piece. Then the entire row is pushed up tight and the jigs are tightened to the table by means of the ⅞-in. bolts. After this is done, the set screws are tightened up to hold the wedges in place while the sides are being planed. As many of the jigs can be used as are required to hold the wedges rigidly on the planer table.



Detail of Jig for Holding Driving Box Wedges on the Planer

This jig has proved to be much more satisfactory for planing wedges than the old method where the wedges were separately clamped to the table and it was necessary to set up the wedges to plane each of the surfaces.

Two Welding Jobs

By E. B. Lewis
Atlantic Coast Line, Rocky Mount, N. C.

A PACIFIC type locomotive cylinder, illustrated in Fig. 1, developed several serious cracks, one of which was in an inner wall between the steam and exhaust passages. Using cast iron filler rods, a successful attempt was made to repair this cylinder by the oxyacetylene welding method as follows: All cracks were beveled and in order to get at the crack in

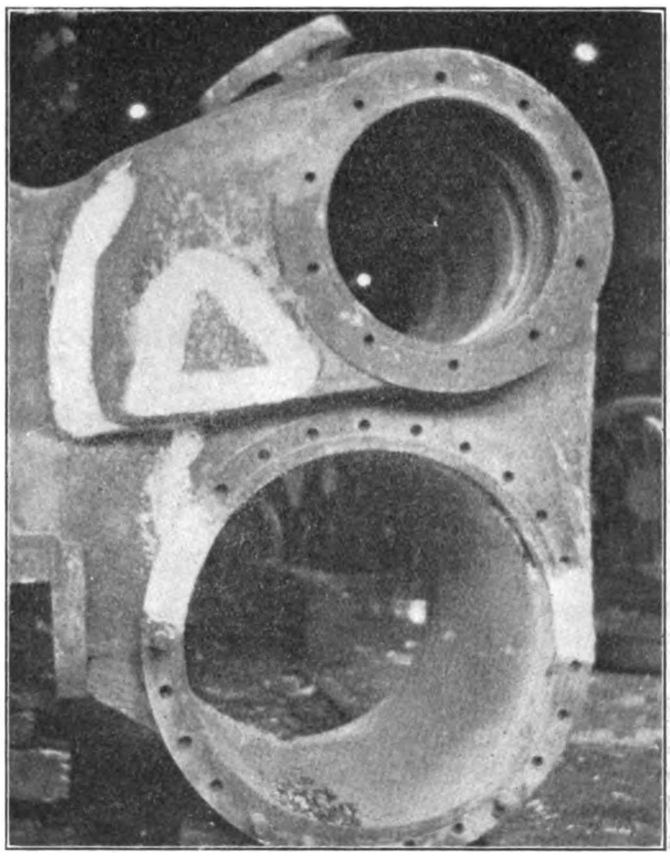


Fig. 1—The Cylinder As It Appeared After Welding

the inner wall a triangular section of the outer wall was cut away at the position indicated in the illustration. A furnace was built about the cylinder in the usual manner, using arch bricks about 12 in. by 16 in. square and preheating the cylinder with a charcoal and scrap wood fire. All cracks were then welded and the cut-out section in the cylinder wall reapplied, using the oxyacetylene torch and cast iron filler rods. This was the first job of its kind on the Atlantic Coast Lines and was entirely successful. Since then other jobs of practically the same character have been performed without removing the cylinders from the locomotives.

A driving wheel center which developed a crack through the wall of the crank pin hole was double veed with a cutting torch, as shown at the left in Fig. 2. The wheel center was then placed on a charcoal fire and all parts heated to a cherry red with the exception of the counterbalance. One side was welded, using Norway iron as a filler material; the wheel center was then turned and the other side welded.

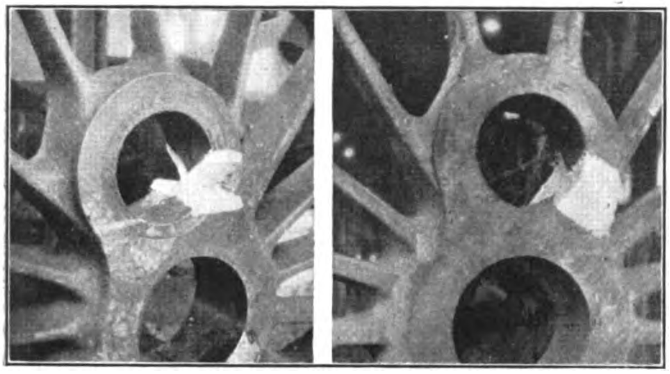


Fig. 2—Driving Wheel Center Before and After Welding

The wheel center was allowed to cool slowly and the 12-in. axle re-applied without refitting. The crank pin hole was bored out and a new pin fitted, which went in at 160 tons. The cost of this job was $30 whereas a new wheel center would cost about $316.

(The two welding jobs illustrated in the report of the proceedings of the Railroad Master Blacksmiths' Association convention, on page 652 of the September, 1923, *Railway Mechanical Engineer* were performed under the supervision of Mr. Lewis at the Emerson shops of the Atlantic Coast Line, Rocky Mount, N. C., these illustrations being included through error with Mr. Young's paper.—Editor.)

Two Handy Machine Tool Attachments

By H. H. Henson

Machine Shop Foreman, Southern Railway, Chattanooga, Tenn.

AN attachment for milling ports in locomotive piston valve bushings is shown in Fig. 1. This was made from a discarded 24-in. lathe chuck and can be used either on a milling machine or horizontal boring mill. Referring to Fig. 1, the base *A* was made of an old bull wheel. The chuck *B* is fastened to the base *A* by means of a stud through the center. The chuck rotates around this stud and is driven by a feed attachment which is connected to the feed on the horizontal boring mill by a universal shaft worm. This worm engages the teeth cut in the chuck, as shown at *C*. The illustration shows the entire attachment clamped to the table and in operation. With an apprentice operating this machine, it only requires from 30 to 40 min. to complete a valve bushing of any size.

Fig. 2 shows a link radius attachment for planing link blocks on a shaper. It consists of a table made from a discarded 24-in. lathe chuck, to which an arm *G* is attached. The chuck is attached to the table *F* of a 30-in. stroke shaper by a stud *D* which acts as a fulcrum about which the chuck can rotate. At *G* is a slot for the stud *C*, the upper end of which carries a roller that fits in the slot on the arm *I*. The slotted arm *I* is attached by two bolts to a bracket *J* on the

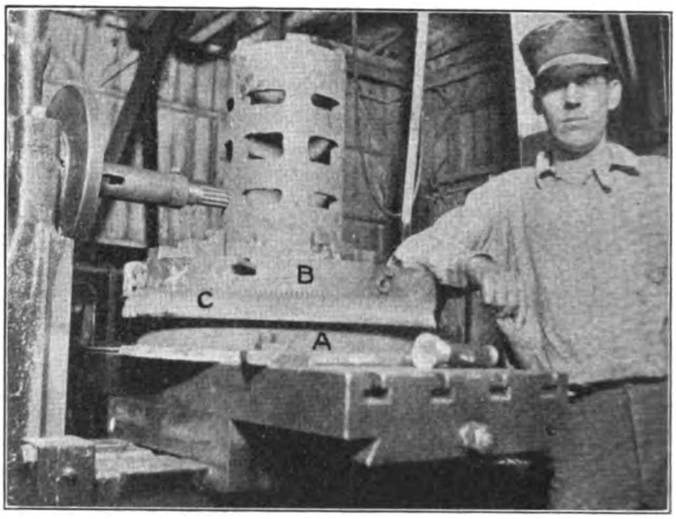


Fig. 1—Piston Valve Bushing Port Milling Attachment

ram. These bolts can be adjusted at *B* to permit the slotted arm *I* being set at any angle desired.

The radius is obtained by using a link templet, or by scribing the radius on a piece of tin and placing it on the table *A*, using a pointer in the tool post *H* to get the proper adjustment of the slotted arm *I*. The adjustment to the radius is made by loosening the nuts *B* on the bracket *J*. One of the bolt holes in the arm *I* is slotted to permit its adjust-

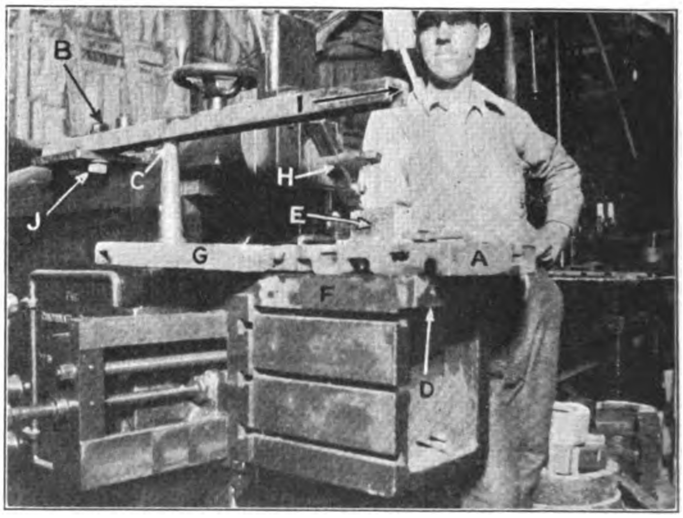


Fig. 2—A Link Radius Attachment for Shapers

ment so as to get the proper swing of the arm *G* and table *A*. The rotation of the table and the straight line movement of the ram combines to give the necessary radial movement for planing the link block.

By using this tool on a shaper instead of on a planer, the tool bit can be operated as fast as it can hold up without destroying its cutting edge. This is advantageous on account of the time that is saved. There are from six to eight speeds on a shaper where there is ordinarily only one speed on a planer. The link, or link block, is clamped on the table *A* by means of two clamps and two bolts. It formerly took from two to three days to plane a link block on an old type planer, where now it requires only two hours to complete the operation with this shaper attachment.

Engine Terminal Operation a Difficult Job

Some Reasons Why—Suggestions for Improvements in Arrangement and in Organization of Work

First Prize*

By E. Gelzer
Mechanical Engineer, Chicago Great Western, Oelwein, Ia.

THERE are very few locomotive terminals today provided with a plant adequate to meet the maximum service required. The prospective vision of future trade and commerce of the country, the condition and reliability of power, the selection of the best location for interchange of traffic, all have an enormous influence on engine terminal operation.

E. Gelzer

Constructive Suggestions for Terminal Improvement

Few construction suggestions have been offered which will enable us materially to increase the efficiency of our present old locomotive terminals. The problem is a difficult one because there so many factors to consider. It is the purpose of this article to offer a few suggestions of what may be accomplished by light rearrangements of labor and facilities within the financial means of any railroad.

It is necessary for an experienced engineer to investigate thoroughly the track conditions —first, the distance from the inbound main track to the coalwharf, ashpits and enginehouse proper; then from the enginehouse to the ashpit and coal wharf to the outbound tracks, keeping in mind the time required for movements and the storage capacity for maximum service in midwinter. In many enginehouses it will be found to pay to rearrange the tracks, keeping the coalwharf in its original position, and simply moving the ashpits. While terminals are generally limited to space it is important that they should always have sufficient room on the inbound and outbound tracks from the main lead to the coalwharf, especially on the inbound. Inspection pits, which are not costly installations, should be placed half way between the inbound main and the coalwharf, or first point of operation. There is no reason why the inspection pits, inspection houses, water station, enginehouse foreman's and dispatching offices, oilhouse, engineers' tool and supply rooms, cannot be combined in one building, or located together, between the inbound and outbound tracks approximately half way between the main lead and the first point of operation. This will expedite the dispatching of locomotives by eliminating the following causes of delays that occur in engine terminals:

1—Time lost in the search for tools and in transferring locomotive equipment to and from the enginehouse.

2—Delays caused through the discovery of defects by the enginemen on the outbound tracks, to repair which mechanics have to journey from the enginehouse, sometimes a half-mile away.

3—Insufficient supervision of enginemen and firemen on arrival and departure on inbound and outbound tracks. This pertains more particularly to freight engines on outbound tracks.

4—Delays due to an overcrowded house with insufficient parking spaces. This means that we must separate the heavy and light running repair work from the dead section and eliminate the interchange of tenders as much as possible from across the turntable. The movement of work engines across the turntable tends to impede the regular routing of available power.

When engines become crowded on the inbound tracks between the ashpits and the enginehouse and die for lack of steam on the way, sometimes a crossover will remedy the situation. Some of the engines have had the fires knocked and others have had the fires cleaned only. The crossover permits the former, on which boiler work will have to be performed and the engine refired, to be separated from the latter, which require less time for light running repairs. It also permits expediting the movement of one engine past another to the ashpit and coal dock, and then to the outbound track, in the case of switch engines. A crossover will reduce delays enormously and save dollars and cents for the railroad.

Conditions Which Slow Up Repairs

Locomotive inspection should be made in an adequate inspection house with glass roof, properly illuminated and heated and provided with well-constructed concrete pits. One of the chief troubles today are the dark, unsanitary and uncomfortable conditions under which inspectors and mechanics have to work. Good inspection means fewer failures. To simplify locomotive repairs, work must be reported before the engine reaches the enginehouse, so that the enginehouse fore-

*This article won the first prize in the Engine Terminal Competiton, first announced in the August, 1923, issue of the *Railway Mechanical Engineer*, which closed October 15.

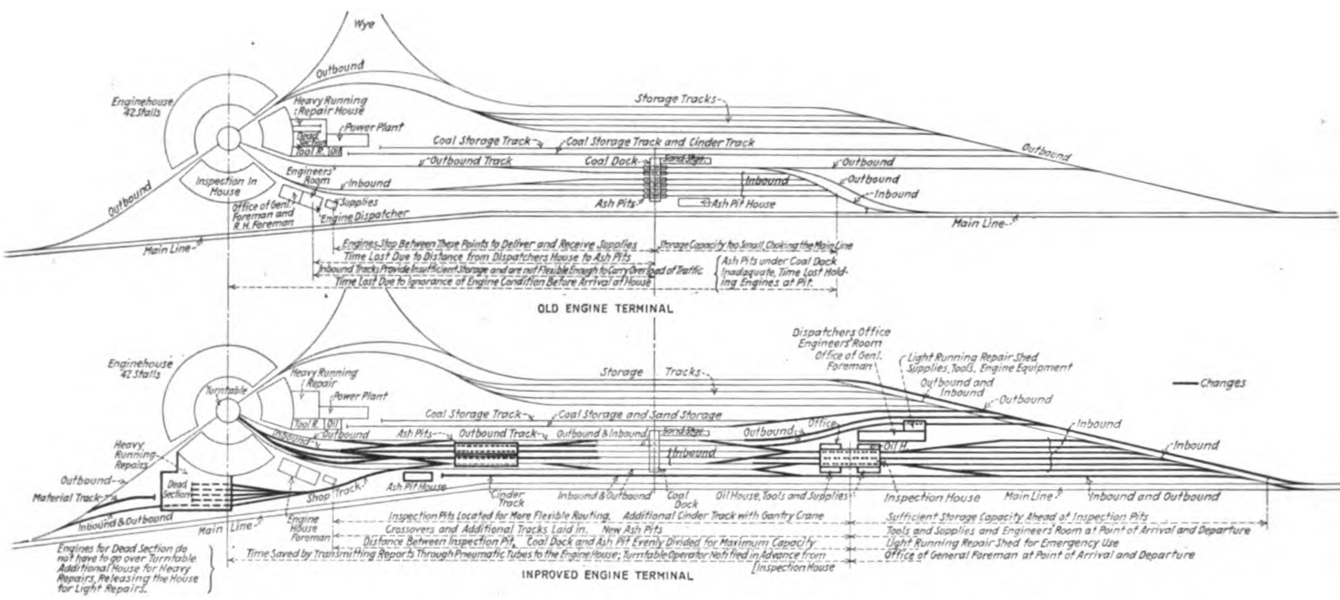
man can anticipate the time when repairs will be completed. The installation of pneumatic tubes from the inspection pit to the enginehouse will save time in transferring work reports. The work reports include those of the engineer and the airbrake, machinery, tender and boiler inspectors as well as the location assignment of engine in the house. The inspector on the outbound track should check the work done by having a copy of all the inspector's slips.

The troubles of the foreman in charge of repairs, in general, are caused by the conditions under which his men are working—their search, for tools and material; the methods of handling heavy parts, and of doing the repair work itself; moving repair parts between the locomotive and the back shop in cases where the enginehouse facilities are inadequate. These we might classify as follows:

1—Time lost by the mechanic in covering the circle; first, to locate the engine; second, to discover the defect; third, to should be carried in stock and what should be manufactured or repaired.

In winter the cold winds that make an enginehouse a most uncomfortable place to work in, through the opening and closing of doors and the poor heating and ventilating systems, account for much waste time in completing repairs. Twice as much work will be done by a man not exposed to severe weather conditions. Automatic or better-operating doors are essential, as is also a smoke exhaust system. In large cities ordinances may require high stacks, but in small towns cheaper arrangements can be made.

Small electric monorail hoists installed in some of our old enginehouses would facilitate the removal and replacement of such parts as smokebox front ends, dome caps, smoke stacks, rods, wheels, braces, etc. All work pits should be free from dirt, ashes and above all, from water. Proper drainage should be sought, if not by gravity, then by a



Concrete Suggestions for Increasing the Capacity of an Engine Terminal by Better Arrangement of Tracks and Other Outside Facilities

get the necessary tools and material together to do the work required.

2—Time lost in reporting deficiencies, either in material, tools or reports.

3—Time lost owing to a lack of proper heating, ventilation and facilities for handling material.

4—Time lost in handling reports—too much red-tape whereby the supervision is prevented from doing proper supervisory work. This pertains particularly to railroads having production systems.

5—Time lost due to inadequate tools for firing up and thawing out engines.

Suggestions That Will Improve Performance

Inspection reports should show on them the stall number to which the engine is assigned. Work slips should be made out from the combined engineer's and inspector's reports, and should show not only the location and the work reported, but also the material required, except in cases where parts are inaccessible to outside inspection. The location of the tool room, material and repair room, should be in the center of the half-circle enginehouse, to be within easy reach of each engine. The maintenance of sufficient locomotive and tender material in stock is something that requires a high type of supervision, and by checking the material lists for two or three years back, from the general storekeeper, one can very easily determine the question of amount of stock to be carried. Here would come the question as to what

good pumping system. Safety regulations should be enforced.

The writer had the opportunity of seeing some especially fine and clean drop pits at the Metz terminal, Alsace, France, after the war. The pits were built with large steps on each side to enable a man to descend quickly and safely, carrying tools and equipment. An electrically controlled hydraulic hoist ran through approximately one-half of the enginehouse, so that it was possible to drop a pair of wheels from under any engine at any time, without waiting two or three days to get on the drop pit. The removable rails over the pits were pivoted and supported by a brace hinged at the top and bottom, and operated by means of a substantial hand lever.

The type of drop pit usually installed in our engine houses has the following defects:

1—Insufficient room for men to work in properly and safely.

2—No way of getting into the pit, except by sliding down.

3—Wheels raised and lowered by hand jacks.

4—Poor method of getting the removable rails out from under the engine.

5—Pits full of water and dirt due to improper drainage.

Many methods of firing up a locomotive have been tried, such as waste soaked with oil, and wood, fired by means of a crude oil torch. With the latter some improvement has been made, where piping is laid, with air and oil hose connections located midway between each pair of stalls, fitted with Barco connections and with sufficient air reservoir capacity to maintain the pressure. Oil burning torches can be used for thaw-

ing out frozen parts of an engine in winter and are much better than saturated waste.

Air should be used at ashpits for cleaning out ashpans. Where there are no stationary air connections, a simple method is to connect a hose to the main reservoir of the engine and blow off the ashes under full 90 lb. pressure.

More practical methods for automatically cleaning the machinery of a locomotive before its arrival at the enginehouse must be found. It is necessary to eliminate the grease and the rods should be clean and dry.

Keeping Engine Failures at a Minimum

This is essentially what every enginehouse foreman tries to do. While the heavy seasonal business will not permit much time in the hands of the mechanical department a quick method is to route all power on which boiler work and heavy running work is not needed direct to the outbound tracks from the ashpits. Where the ideal arrangement of a combined inspection pit, general office, tool equipment and oil house can be located near the outbound track it is well to provide an additional small shop for light repair where in an emergency a small force of men can be available to do quick work. An outbound inspector and closer supervision is essential in this case. Good judgment has to be used, especially where pins and bearings are reported. Lubrication should be doubly controlled and all boiler tests, washouts, etc., carried out thoroughly and regularly.

The method of reporting engine failures to a special foreman will often tend to expedite repairs. If an engine failure occurs on the division, the cause of the failure is telephoned from the nearest tower by the locomotive engineman and the report is analyzed and preparations made for repairs before the engine arrives at its destination, by the special foreman or inspector in charge. The success of this arrangement depends on a proper system of reporting to insure the transmission of the necessary information. These foremen or inspectors closely follow up defects which tend to become epidemic, in order to have them remedied before actual failures occur. Thus, reports of failures in detail can be quickly forwarded to the higher officers for investigation.

Shoe and Wedge Line Chuck

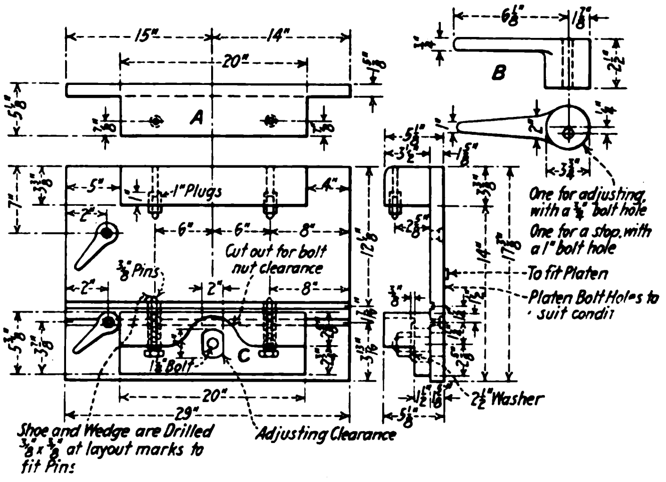
A CHUCK designed to eliminate any chance of error when setting up a shoe or wedge for planing to line, is shown in the sketch. It has been found that this chuck saves considerable time in setting up and also simplifies the work to such an extent that a mechanic of ordinary ability can handle one of the most important jobs in a locomotive machine shop.

In setting up a shoe or wedge in an ordinary chuck, the operator is required to set the work so that a surface gage will exactly enter the three layout marks. However, if it so happens that one side of the layout mark is 1/16 in. or 1/32 in. high, the engine will tram just as well as though it were set exactly to gage. This is generally accepted as evidence that the work is accurate, although it maybe wrong.

The construction of the chuck is shown in the sketch. It consists of a base 1⅝ in. thick, on which are placed two blocks, *A* and *C*, 3½ in. high, that function as jaws in holding the work. The jaw *A* is provided with two ⅜-in. pins placed exactly 12 in. apart. Neither the jaw *A* nor the two pins are adjustable, however, the adjustment is taken care of by the jaw *C*, in which are contained two ⅜-in. pins, that can be moved in or out, for holding the opposite side of the wedge or shoe. The adjustment of the jaw *C* is made possible by means of a slot, through which is passed a 1¼-in. bolt, which can be tightened to hold the jaw *C* at any desired distance from *A*.

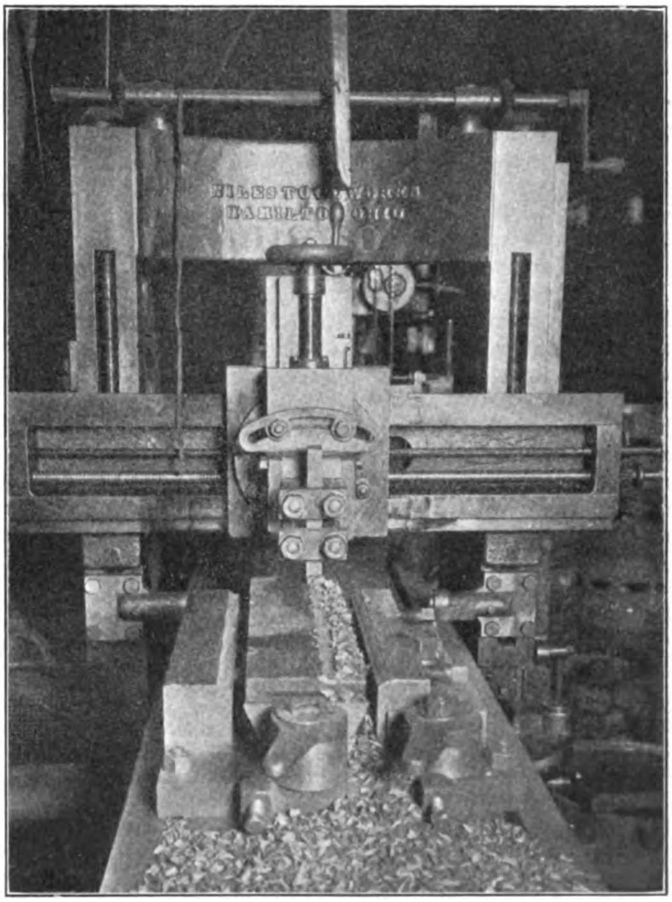
Two stops *B* are provided, one to hold the work and the other to hold the jaw *C* from moving endwise. These stops are drilled ¼-in. off center and, by turning the handle, they can be tightened against the work so as to withstand the thrust of the tool. A separate detail of the stops is also shown.

It is essential that the man who lays out the shoes and wedges scribe the outer marks exactly 12 in. apart, but the



Sketch of Chuck for Holding Shoes or Wedges While Planing to Line

inner mark can be scribed at any place near the bottom on account of the jaw *C* being adjustable. After the shoes and wedges are laid out, each mark serves as a center for drilling a ⅜-in. hole about ⅜ in. deep.



A Chuck That Insures Accurate Planing of Shoes and Wedges

As shown in the illustration, the shoe or wedge is placed on the ⅜-in. pins in *A* and *C*. The 1¼-in. bolt through the jaw *C* is tightened and the ⅜-in. pins in the jaws screwed tight. The stops *B* are then turned against the work and the jaw *C* so as to receive the thrust of the tool.

Planning Department for Railroad Shops

Just as Essential as in a Successful Manufacturing Organization—How It Can Be Developed

Second Prize*

By M. H. Williams

A BADLY managed shop is wasting the stockholders' money. A well managed shop becomes a good asset. The amount of money that can be saved owing to good management will, in many cases, amount to a very comfortable sum.

Examples From Industries

Before going into the consideration of railway shop management it would be well to examine a few successful business ventures to see if we may profit from them. For instance, at the present time American automobiles are sold all over the world for the very simple reason that they are not only superior but also cheaper than those made in other countries; while the rate paid workmen per day is much higher than abroad, the actual labor cost of each piece or completed car is much lower. This happy condition has been brought about by standardizing the parts, the use of machine tools well adapted for each purpose, the use of jigs, gages and other special appliances. In order to bring this about it has been necessary to employ a large number of specialists who are devoting their time to devising and working up ways and means to produce the various parts, making the completed whole at the lowest labor cost. It goes without saying that these specialists have been a good investment or the practice would not have become universal among the large number of concerns who are in the business for one prime object, which is to make money. Railroads can take a lesson from these concerns.

Another example is the electric manufacturing concerns. The fact that a first class ¼-hp. motor can be bought over the counter in any store for $25, which includes the dealer's profit of some 15 per cent; selling costs about 20 per cent; advertising, overhead expenses of shop, etc., shows that the labor costs must be exceedingly low. This condition has also been brought about by specializing, by the use of punches and dies, special jigs and fixtures, and studying each operation in order to reduce labor costs to a minimum, or more properly speaking to obtain the maximum output per man per day.

Another example is the steel mills. A visitor to these mills is at once struck with the small number of men employed for the large tonnage turned out. This happy condition of employing mechanical equipment for practically all operations has resulted from a large amount of study of each operation. The steel people were long-headed enough to see that money could be spent that would bring in a large return by adopting all the latest devices, or designing special devices to increase the output per man.

Another example is the oil industry. Great fortunes have been made by the leading oil companies, not as is often supposed because of the high price charged for kerosene or gasoline, but from the by-products. Years ago the principal product of the crude oil was kerosene; today it is kerosene, gasoline, paraffine, roofing and road tar, and many other materials. As a result they are making money from what was at one time thrown away. To make the barrel of crude oil produce all these articles has taken a large amount of research and experimenting. However, the fact that the oil companies make money is sufficient evidence that it has been a profitable investment.

A Planning Department

With all these examples before us, why should not the railroad shop adopt the planning scheme and employ men for no other purpose than to devise methods for making new parts or making repairs in the least amount of time. This, no doubt, will be answered off-hand by some of the railway shop people saying that they are not manufacturing in large quantities, but are only repair shops where each day brings forth new propositions that must be met for the day. Granting this, the work of a large shop will be to manufacture new locomotive and car parts and also to make repairs to locomotives and cars, which work does not differ enough from day to day to prevent a large amount of standardizing of parts and methods of doing work.

The next question that comes up will be. Where are these planning men to be obtained? This may be answered by saying that most railway shops have a number of natural "geniuses in the rough" and it is only necessary to pick them out and properly develop them in order to inaugurate a planning department. This would be doing exactly what the manufacturing concerns which have highly developed planning departments have already done.

Picking Men for Planning Department

How shall we go about picking out the men? This may be partly answered by explaining a system in vogue in one of the leading tool making concerns. This company has a number of boxes, similar to mail boxes, placed in the shop. Every employee is invited to criticize or suggest improvements relating to any machine they make, or operation performed. These are gathered up and carefully gone over by the proper parties. Should a suggestion possess value it is acted upon. Some of the criticisms from the workmen have resulted in radical changes and improvements in the products. This is a case where every genius in the shop is trying to improve the product and therefore becomes an adjunct or extension of the designing or planning department. A simple expedient like this in railway shops will bring out suggestions from the men which will have a two-fold object: First, valuable suggestions will be made. Second, the natural genius will reveal himself.

As an extra incentive for suggestions which appear to have sufficient merit to put in use, a reward such as a $5 bill and letter from the man higher up would have a good effect. A man working at a bench or machine generally is very much pleased when complimented on some improvement he has suggested. It goes without saying that a man who makes an honest suggestion for a way to improve conditions should always be encouraged. If the idea proposed is as old as the hills the man should be diplomatically told about it and if a description has been published in books or magazines he should be requested to read what has been published. This will let the man down easy and not throw a

*Awarded the second prize in the Shop Management Competition, which closed September 15, 1923. The first prize article was published in the January issue, page 39.

damper on his ardor. It is very much to be feared that many valuable suggestions have been turned down or lost and natural geniuses remain undiscovered simply for lack of diplomacy when dealing with them.

A few suggestions from one man will draw attention to him; he then becomes a candidate for the planning department and when conditions admit should be placed in a position where he can develop into a member of that department. However, to develop into a first-class planner takes time and study on the part of the man, since there are but few men who can step from the shop into a position as first-class planner without a certain amount of preliminary training. By adopting this plan for discovering geniuses a list of candidates will be available when they are needed.

Asking for Specific Suggestions

In railway shops it would be advisable to invite suggestions on specific operations which could be posted on the shop bulletin board. As a suggestion the following are offered:

Taper Frame Bolts.—A possible change in method or design for tools, gages, etc., to do away with the bolt turner leaving his machine for purpose of taking measurements.

Driving Boxes.—A method by which the bore of box and hub face will be machined to correct size and avoid spotting on the axle so the box can be placed in service without fitting at time of applying.

Boiler Patches.—A system by which the patches may be applied in less time.

Steel Car Patches.—The most desirable sizes to be kept in stock to meet general repair conditions.

Milling New Side Rods and Main Rods.—Fixtures for holding rods that will reduce set-up time, or time between milling operations.

Cylinder Packing Rings.—A method of measuring cylinders, pistons and rings by which the packing rings may be turned to fit piston grooves, also the cylinders and rings cut without the boring mill operator leaving his machine to take measurements.

Suggestions made by the men on subjects similar to the above can be gone over to good advantage by the proper parties; if they look promising they can be acted upon by assigning a draftsman to put the scheme in proper shape when the suggestion is in the nature of a jig, template, tool, etc., or, should the man making the suggestion be able to do so he should be requested to make a drawing of such mechanical details as may be necessary. A few cases of this kind will stimulate the workmen. The fact should not be lost sight of that railway shops are in need of mechanical geniuses who can suggest good practical schemes to improve shop methods of turning out new and repair work.

In many shops there is a certain amount of lost time because of waiting on other departments for new material, repair parts, etc. The workmen are quick to notice these delays, especially when working piece-work; in fact they generally know more about them than the foreman. An incentive to reduce this item of idle time would eventually result in reducing the little delays that in the aggregate amount to considerable time. The argument may be advanced that the workmen will not suggest improvements that may in the long run reduce the amount of work. The writer believes this to be wrong. The railway shop employee is, as a general proposition, a good reliable fellow who wants to get ahead and has a great amount of pride in what he does and who would like his shop to have the name of being a little better than any other. Many of these men are stockholders, or at least should be, who can see the value of dividends coming from improved methods; therefore it is not fair to say that they will not do all in their power for the shop in which they are employed. Again there is the incentive of rewards and the possibility of promotion.

Shop and Terminal Construction in 1923

Many New Projects and Additions to Maintenance Facilities Partially Completed in the Past Year

The past two years, after a lapse of about eight years, have been notable for the development of a large number of programs of extensive new construction of shop and engine terminal facilities. While a few outstanding back shop projects are listed in the programs under way during 1923, such as the $3,380,000 shop of the Pennsylvania at Altoona, Pa., and the $2,000,000 Denver shop project of the Chicago, Burlington & Quincy, by far the largest part of these projects have been new terminals or the rebuilding and extension of old engine terminals, with accompanying shop facilities for the better handling of running repairs. It will also be noted that car repair facilities have come in for considerable attention, a number of car repair shops being included in the list of last year's construction.

Attention is also directed to the fact that a large number of the projects recorded in 1923 are only partially completed and will continue well into 1924 before completion. In addition to these carry-over projects, a considerable volume of new construction will be undertaken. Among the outstanding new projects on which large expenditures will be made during 1924, may be mentioned a $3,000,000 shop improvement program of the Atchison, Topeka & Santa Fe at San Bernardino, Cal.; a $1,300,000 program of shop improvements on the Norfolk & Western, and a program amounting to $1,000,000 on the Erie. The Illinois Central also plans to spend $700,000, in this case all for shop tools and equipment.

Partial List of Construction in 1923

A partial list of the construction in 1923 follows:

Atlantic Coast Line.—Car repair yard and shed at Sanford, Fla., cost $112,000 (completed). Extension of coach repair shed at Waycross, Ga., cost $112,600 (90 per cent completed). New coach and paint shops at Rocky Mount, N. C., cost $460,000 (25 per cent completed). New shop facilities at Montgomery, Ala., cost $420,000 (10 per cent completed).

Baltimore & Ohio.—New office building at Mt. Clare shops, Baltimore, cost $201,500 (80 per cent completed). Engine terminal improvements at Grafton, W. Va., cost $400,000 (completed).

Birmingham Belt.—New engine terminal at East Thomas, Birmingham, Ala., cost $636,600 (70 per cent completed).

Boston & Maine.—New locomotive repair shop, 170 ft. by 200 ft., at Concord, N. H., estimated cost $310,000 (78 per cent completed).

Buffalo, Rochester & Pittsburgh.—New ash handling facilities, inspection pits and other terminal improvements at East Salamanca, N. Y., cost $175,000 (completed). Additional yard tracks, new storehouses, shop buildings and other improvements at Cloe, Pa., cost $123,000 (completed).

Central of New Jersey.—Grade crossing elimination, new engine terminal, etc., at Somerville, N. J., cost $2,000,000 (5 per cent completed).

Chesapeake & Ohio.—Machine shop at Peach Creek, W. Va.,

cost $109,600 (completed). Addition to roundhouse at Peach Creek, W. Va., cost $100,000 (completed).

Chicago & Eastern Illinois.—Purchase of property for new terminal at Evansville, Ind., cost $175,000 (80 per cent completed).

Chicago & North Western.—Two mechanical coaling chutes at Chicago shops, cost $95,000 (completed). New engine terminal at Madison, Wis., cost $540,000 (90 per cent completed). Ten-stall addition and extension of present enginehouse, including several terminal changes at Casper, Wyo., cost $238,000 (90 per cent completed).

Chicago, Burlington & Quincy.—New locomotive repair shops, tracks, etc., at Denver, Colo., cost $2,000,000 (90 per cent completed). Installation of new turntables along line, cost $97,000 (completed). Engine terminal improvements at various points, cost $464,000 (95 per cent completed). New water treating plants at points along line, cost $173,000 (75 per cent completed).

Chicago, Rock Island & Pacific.—Installing storage and roadside locomotive fuel oil tanks on Arkansas-Louisiana division, cost $225,000 (completed).

Colorado & Southern.—Reconstruction of 16 stalls and addition of ten stalls to enginehouse at Trinidad, Colo., cost $150,000 (completed).

Denver & Rio Grande Western.—Shop improvements at Burnham, Colo., cost $886,000 (28 per cent completed). Shop improvements at Salida, Colo., cost $342,000 (65 per cent completed). Shop improvements at Grand Junction, Colo., cost $242,000 (70 per cent completed). Shop improvements at Alamosa, Colo., cost $158,400 (75 per cent completed). Shop improvements at Salt Lake, Utah, cost $1,167,000 (35 per cent completed).

Detroit Terminal.—Eight-stall addition to enginehouse, including new machine shop and storehouse facilities at Davidson yard, Detroit, Mich., cost $115,000 (completed).

Elgin, Joliet & Eastern.—Fourteen-stall addition to reinforced concrete roundhouse at East Joliet, Ill., cost $183,279 (completed). Steel car repair shop, 500 ft. long by 300 ft. wide, at East Joliet, cost $577,422 (85 per cent completed). Twenty-stall addition to enginehouse at Kirk yard, Gary, Ind., cost $269,761 (completed).

Erie Railroad.—Adding a 107-ft. by 410-ft. extension to erecting shop, installation of 250-ton gap crane, etc., at Hornell, N. Y., cost $560,000 (95 per cent completed).

Florida East Coast.—New engine terminal facilities at New Smyrna, Fla., cost $165,000 (15 per cent completed).

Great Northern.—New engine terminal at St. Cloud, Minn., cost $410,000 (completed). Engine terminal at Fargo, N. D., cost $185,000 (completed). Replacing turntables at four different points on system, cost $124,920 (completed). Car repair shop at St. Paul, Minn., cost $117,900 (completed). Extension to car repair shop and the construction of a lumber shed at St. Cloud, Minn., cost $125,200 (completed).

Gulf & Ship Island.—New enginehouse and other shops at Gulfport, Miss., cost $90,000 (completed).

Illinois Central.—New yards, shops and engine terminal facilities at Markham yard near Homewood, Ill., cost $8,793,000 (50 per cent completed). Rearrangement of mechanical facilities and other improvements at Central City, Ky., cost $1,636,000 (50 per cent completed). New passing tracks and coaling facilities at Gilman, Ill., cost $174,000 (65 per cent completed). Additional tracks and coaling facilities at East St. Louis, Ill., cost $130,000 (60 per cent completed). New engine terminal and reconstruction of yard at Council Bluffs, Ia., cost $276,000 (90 per cent completed).

Kansas City Southern.—Extensions to machine shop, 152 ft. by 252 ft., at Pittsburg, Kan., cost $250,000 (completed). Extension to enginehouse, 8 stalls, at Pittsburg, cost $120,000 (30 per cent completed).

Lake Superior & Ishpeming.—New car shops, paint shop, etc., at Presque Isle, Mich., cost $197,000 (completed).

Lehigh & New England.—Grading and laying tracks for new engine terminal, 10-stall enginehouse, coaling station, etc., including revision of main track at Tamaqua, Pa., cost $227,000 (75 per cent completed). Building facilities, etc., for Tamaqua terminal, to be started in 1924, estimated cost $235,000.

Los Angeles & Salt Lake.—New terminal facilities, including freight yards, enginehouse and shops, at Los Angeles, cost $1,750,000 (75 per cent completed).

Louisiana & Arkansas.—New shops and yards at Minden, La., cost $700,000 (90 per cent completed).

Louisville & Nashville.—New machine shop at Etowah, Tenn., cost $252,255. New machine shop at Corbin, Ky., cost $331,906.

Michigan Central.—New enginehouse at Grand Rapids, Mich., cost $110,000 (completed). New coaling and water supply stations at Augusta, Mich., cost $167,500 (completed). New engine terminal facilities at Lansing, Mich., cost $178,000 (completed). Completing remaining work at the Niles, Mich., engine and freight terminal, cost $545,000 (completed).

Minneapolis, St. Paul & Sault Ste. Marie.—New 20-stall enginehouse, machine shop and other terminal facilities at Gladstone, Mich., cost $151,500 (completed).

Missouri, Kansas & Texas.—New freight terminal, enginehouse facilities and grade separation at Denison, Tex., cost $3,200,000 (completed). New locomotive repair shop, office buildings, machinery, etc., at Waco, Tex., cost $1,500,000 (completed). Six-stall addition to roundhouse, new power house and hotel at New Franklin, Mo., cost $220,000 (completed). Installation of water treating plant on system, cost $200,000 (completed). Rearrangement and enlargement of car repair shops at Denison, Tex., cost $330,000 (40 per cent completed).

Missouri Pacific.—New shop facilities at St. Louis, cost $645,000 (completed). Installation of fuel oil handling facilities on southern district, cost $300,000 (completed). New machine shop at Wichita, Kan., cost $135,000 (completed).

Mobile & Ohio.—New engine terminal, including 24-stall roundhouse, 500-ton concrete coaling plant, cinder conveyors, etc., at Iselin, Tenn., cost $320,000 (50 per cent completed).

New Jersey, Indiana & Illinois.—New engine terminal and facilities, cost $250,000.

New York Central.—Renewal of turntables at Buffalo, N. Y., cost $178,000 (46 per cent completed). Improvement in water facilities at Wende, N. Y., cost $108,000 (25 per cent completed).

New York, New Haven & Hartford.—Construction of 12-stall extension to enginehouse at Cedar Hill, cost $238,000 (60 per cent completed). Construction of 12-stall brick enginehouse at Boston, Mass., cost $162,000 (99 per cent completed). Construction of inspection pits and other attendant facilities at various terminals on the system, cost $160,000 (95 per cent completed).

Norfolk & Western.—New terminal facilities at Hagerstown, Md., cost $148,000 (completed). New tracks and terminal facilities at Auville, W. Va., cost $765,000 (80 per cent completed).

Northern Pacific.—New power plant at Glendive, Mont., cost $147,000 (completed). New 28-stall enginehouse at Missoula, Mont., cost $250,000 (70 per cent completed).

Oregon Short Line.—New two-story and basement addition to storehouse at Pocatello, Idaho, cost $153,000 (completed). New 150-ton coaling plant, etc., at Orchard, Idaho, cost $107,000 (10 per cent completed).

Oregon-Washington Railroad & Navigation Co.—New fuel oil stations on system, cost $254,000 (completed).

Pennsylvania System.—Renewal of turntable at Jersey City, N. J., cost $100,000 (20 per cent completed). Reconstruction of enginehouse at Elmira, N. Y., cost $136,000 (50 per cent completed). Steel freight car repair shops at Enola, Pa., cost $415,000 (completed). Construction of additional shops at Altoona, Pa., cost $3,380,000 (47 per cent completed). New engine terminal facilities at Hagerstown, Md., cost $300,000 (completed). Improving enginehouse facilities at Conemaugh, Pa., cost $517,000 (85 per cent completed). Steel freight car repair shop at Pitcairn, Pa., cost $741,700 (completed). New enginehouse facilities at Sharpsburg, Pa., cost $1,000,000 (30 per cent completed). New enginehouse and coach yard at Detroit, Mich., 1923 expenditures $900,000 (75 per cent completed). New 34-stall enginehouse, shops and other passenger engine terminal facilities at Columbus, Ohio, cost $3,402,700 (80 per cent completed). Additional yard and car repair facilities at Grogan yard, Columbus, cost $255,700 (completed).

Pere Marquette.—Additional shop buildings and equipment at Grand Rapids, Mich., cost $1,500,000 (55 per cent completed). New engine terminal, yards, and facilities at Erie, Mich., cost $2,000,000 (30 per cent completed). New engine terminal and coach yard at Detroit, cost $1,200,000 (80 per cent completed).

Philadelphia & Reading.—New one-story reinforced concrete and brick oil house with complete system for storage at Reading, Pa., cost $170,000 (completed).

Portland Terminal Company.—New 40-stall enginehouse, boiler-washing plant, coal and ash handling facilities and westbound classification yard at South Portland, Me., cost $1,750,000 (80 per cent completed).

Richmond, Fredericksburg & Potomac.—New locomotive terminal, machine shop, coaling station, etc., at Acca, Va., cost $1,000,000 (95 per cent completed).

St. Louis-San Francisco.—New engine terminal at Lindenwood, St. Louis, Mo., cost $900,000 (80 per cent completed).

St. Louis-Southwestern.—Installation of fuel oil facilities along line, cost $100,000 (75 per cent completed). Installation of fuel oil facilities for storage and handling at various points on the Texas lines, cost $167,000 (completed).

Southern Railway.—Additions to existing shop buildings and construction of new boiler house, engine drop pit and additional machines at Alexandria, Va., cost $105,000 (75 per cent completed).

Southern Pacific.—Additional equipment and 80-ft. extension

to machine shop at Los Angeles, Cal., cost $610,000 (50 per cent completed). Extension to present machine shop, 84 ft. by 258 ft. to serve as erecting shop at El Paso, Tex., cost $231,243 (completed). Rearrangement and expansion of engine terminal of El Paso, cost $243,016 (50 per cent completed). Remodeling treating plant and installing power plant at Englewood, Tex., cost $118,312. (91 per cent completed). Rearranging and expanding engine terminal at Lafayette, La., cost $447,878 (35 per cent completed).

TOLEDO, ST. LOUIS & WESTERN.—New 27-stall enginehouse, offices, etc., at Frankfort, Ind., cost $300,000 (20 per cent completed).

ULSTER & DELAWARE.—Extension of locomotive erecting shops, etc., at Kingston, N. Y., cost $105,000 (completed).

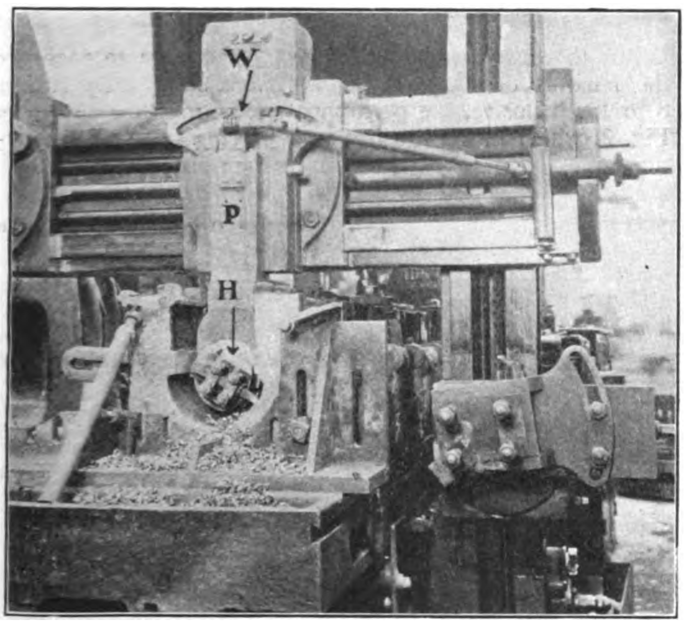
WESTERN MARYLAND.—New storeroom and office building at Hagerstown, Md., cost $185,000 (75 per cent completed). New steel car repair yard, including paint shops, store houses, etc., at Port Covington, Baltimore, Md., cost $115,000 (completed).

WESTERN PACIFIC.—Extending machine and erecting shop and installation of additional cranes at Sacramento, Cal., cost $100,000 (75 per cent completed).

Machining Driving Boxes

THE following method of machining driving boxes may be of interest as representing the practice at the Billerica shops of the Boston & Maine, one of the large railroad repair shops in the east.

The boxes are first put on the planer table, flat side down, in two rows, 16 and sometimes more boxes being planed at one time. The first operation is to plane the top and one shoe and wedge way on each row of boxes, using all four planer heads at the same time. The boxes are turned over and the operation repeated, planing the bottom and the other shoe and wedge way. The boxes are then set up face



A Rugged Radius-Planing Attachment

to face on the planer table, properly strapped and bolted in correct alinement, and the cellar fits planed. Crown brass fits are machined, using the radius-planning attachment shown in the illustration. This attachment is the second one of its kind used in the shop and of extremely rugged construction. The cutting tool is 3/4 in. by 1 1/2 in., and takes a 1/2-in. chip using a 1/16-in. feed in cast-iron. With steel boxes the feed is 1/32 in. The driving boxes are cornered in accordance with the usual practice by setting them on their narrow sides at a slight angle with the planer table as required and planing the taper.

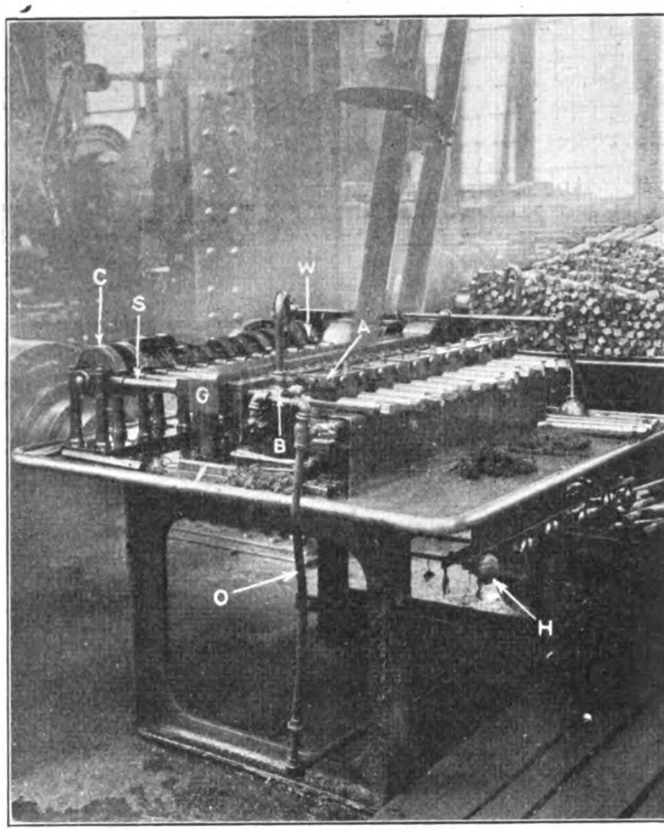
This radius-planing attachment is worthy of special attention in view of its unusually rugged construction. The cutting tool is held in a tool holder *H* arranged to rotate on a pin of large proportions in tool post *P*. The tool post is designed to withstand the severe duty imposed on it by rotating a cutting tool 12 or 18 in. below the planer cross rail. Tool post *P* is an accurate fit in the standard planer clapper box, being suspended by the usual pin on which it swings outward on the return stroke.

Power feed is provided for this attachment by means of worm *W*, a spur gear on a vertical shaft back of the tool post and bevel gears connecting to the tool holder *H*. Worm *W* is driven by means of two universal joints and an extension rod from the standard planer feed rod and feed mechanism.

Machine for Drilling Telltale Holes

THE machine illustrated is installed at the Readville shops of the New York, New Haven & Hartford and is used for drilling telltale holes in rigid staybolts before application to the boilers. While by no means a new machine, it effects an important saving in time and labor for this operation, and may not be familiar to all railroad shopmen.

The machine consists of a compact and substantial table on which is mounted a mechanism for holding the staybolts, driving the drill spindles, and feeding the spindles. Six air chucks, one of which is shown at *A* in the illustration, are arranged to hold two staybolts each and to be operated by six handles *H*. Suitable adjusting screws are provided on



Twelve Staybolt Telltale Holes Can Be Drilled at the Same Time on This Machine

the chucks and this arrangement enables the staybolts to be put in and released from the machine with a minimum effort. Twelve staybolts can be accommodated in the machine at one time and 12 drill chucks *B* are therefore provided, direct connected to 12 spindles *S* and driven by a train of spur gears from the tight and loose pulley shaft indicated.

The drill spindle feed is obtained by the action of six pairs of cams *C*, driven by a worm gear *W*. Twelve coil springs which, together with the driving gears, are carefully

inclosed under the guard plate *G*, provide for the return of the spindles after the holes are drilled. Suitable connections are made from the oil pipe *O* to permit flooding the drills, insuring that they are well lubricated and cooled. The air chucks operate independently so that the staybolts can be removed and new ones supplied in one pair of chucks while the others are working. With a suitable arrangement, whereby staybolts are within easy reach of the operator, a very large production of drilled telltale holes can be obtained with this machine.

Hose Repair Job

By Observer

THE hose repair job at one important railroad shop has been systematized and special machines devised to facilitate the work as shown in the illustrations. With these facilities 328 hose are completely stripped and the fittings reassembled with new hose by one man in eight hours.

The following are the operations as they occur, together with the time taken by stop watch on one of these hose:

Description of operation	Time taken, in seconds
1—Cut first bolt in clamp	¾
2—Open first clamp	3
3—Turn end for end and cut second bolt	¾
4—Open second clamp	3
5—Place hose in stripping machine	3
6—Open valve and strip both castings. This operation removes the nipple and coupling from the hose	3
7—Close valve which opens vise and remove hose from machine	2
8—Apply cement to coupling and place on applicator	3½
9—Apply cement to nipple and put it on applicator	3½
10—Slip two hose clamps on new hose	3
11—Place new hose with clamps in air vise	1½
12—Open valve and press both nipple and coupling in new hose simultaneously	5
13—Close valve and remove hose from vise	3
14—Place hose and clamp on vise in position for bolting	4½
15—Close first clamp, using foot valve to operate closing device	3½
16—Apply bolt to clamp	3
17—Start nut on bolt by hand	5
18—Tighten nut with machine	4½
19—Turn hose end for end	2
20—Place second clamp in position for closing	1
21—Close second clamp (same as operation 15)	3
22—Apply bolt to clamp (same as operation 16)	4½
23—Start nut on bolt by hand (same as operation 17)	4
24—Tighten nut by machine (same as operation 18)	4
25—Remove from machine, completed	1
Total time	75

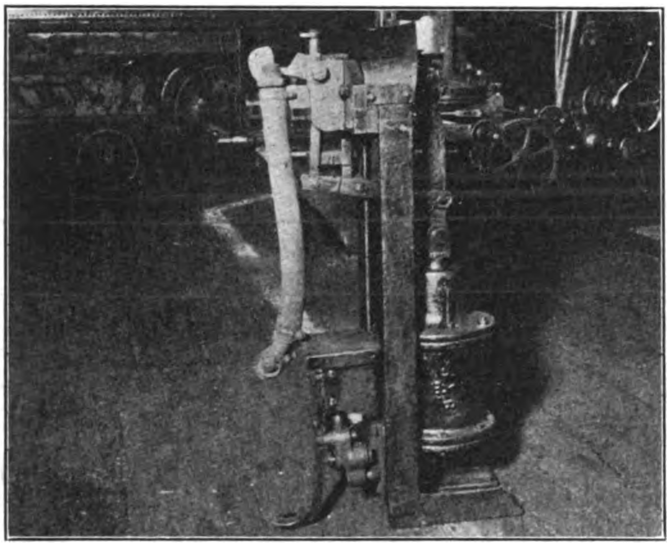


Fig. 1—Foot-Operated Machine for Cutting Clamp Bolts

The time of these individual operations will vary greatly in a day, hence the total time of this one, 75 seconds, is somewhat exceeded when a total of 328 have been stripped and reassembled. It is more than probable that several of these operations would take longer on a second trial and quite as many could be done quicker, but the one given is a fair average. On a special test all the 25 operations required for stripping fittings and remounting on a new hose have been successfully completed in 61 seconds.

Fig. 1 shows the foot-operated bolt cutting machine on which operations 1 to 4 are performed. This machine cuts the clamp bolt and on the return or upward stroke of the

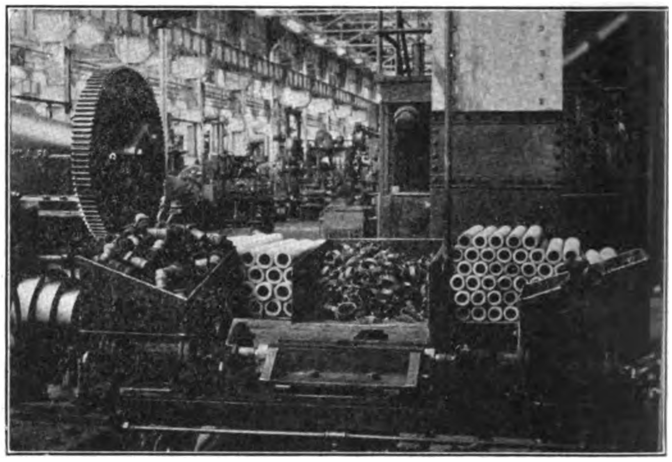


Fig. 2—Forcing Salvaged Connections Into New Hose

knives the lugs on the clamps are forced open to facilitate the removal of the coupling at operation 6. Operations 8 to 13, inclusive, are performed on the machine shown in Fig. 2, which in the illustration is forcing salvaged connections into the new hose. The final operations, 14 to 25, are performed on the machine shown in Fig. 3.

It should be understood that after the old hose has been

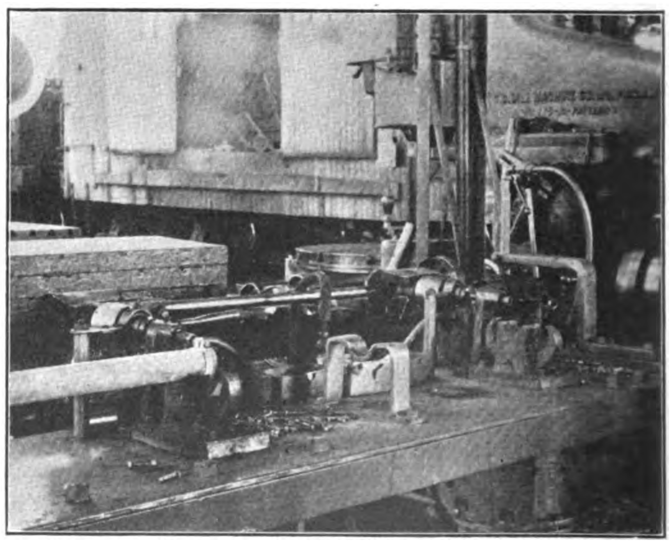
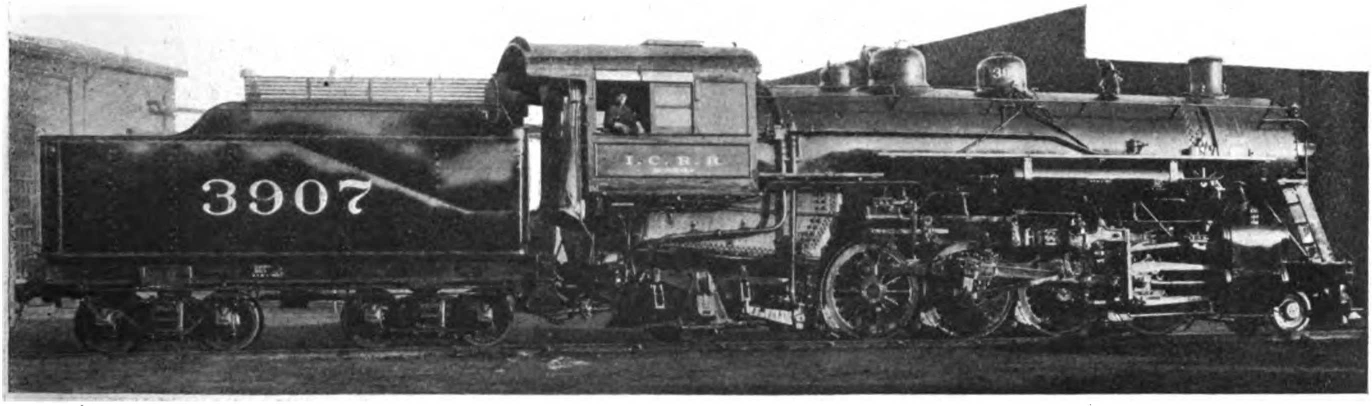


Fig. 3—The Final Operations Are Performed on This Machine

stripped the couplings and nipples are salvaged. This consists of renewing the gaskets, cleaning the grooves, repairing the pins and gaging all parts of the coupling with a standard Westinghouse test gage made for this purpose. These salvaged parts are then piled in the compartments which are shown in Fig. 2.

I. C. Builds 24 Mikados at Burnside Shops

Interesting Methods of Handling the Work in Conjunction with Normal Heavy Repair Output



One of the New Locomotives Built at Burnside

THE Illinois Central has recently completed the construction of 24 new Mikado locomotives in the company shops at Burnside, Ill. Particular interest attaches to this work because of special methods developed and because the work was handled with essentially no reduction in normal heavy repair output.

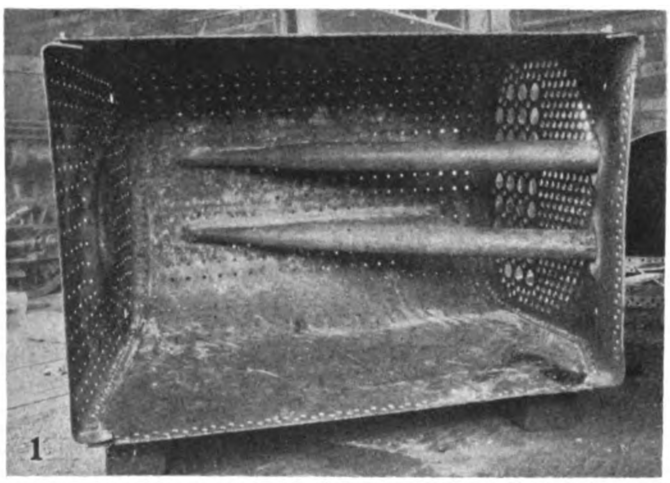
Material for the new locomotives was ordered in March, work started on the heavy castings and forgings in June, and the first locomotive was completed ready for service in August, 1923. The balance of the locomotives were turned out as follows: September, three; October, six; November, six; December, six; January, two. In addition, the normal shop output of approximately 23 heavy and 20 light repairs a month was maintained, the former figure containing a considerable number of locomotives which received new fireboxes, new cylinders and superheater equipment, or other unusually heavy work.

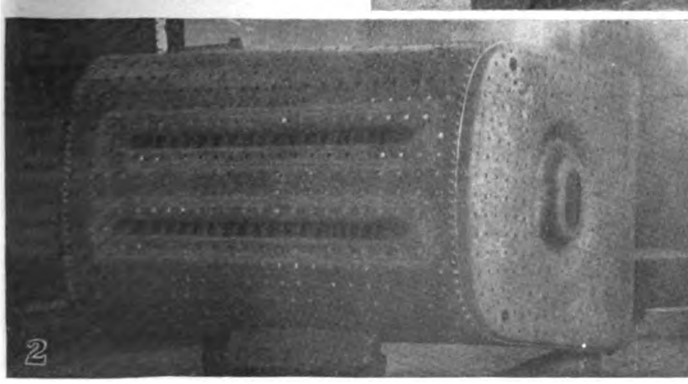
The shop forces were not increased materially to handle the new work; the number of men employed in the locomotive shop exclusive of the supervision was 1,786 in June and only 1,807 in December when the new work was probably at its peak. The various gangs were reorganized, however, into two and three shifts, as the work warranted and the extra shifts could be used to advantage.

One reason for the rapid progress of the work was unquestionably the ingenuity and resourcefulness of foremen and supervisors in designing tools, jigs and devices for facilitating difficult operations. Moreover all hands seemed interested in the work and on the whole put forth their best efforts. This may have been by way of showing appreciation to the management for bringing this work to Burnside and keeping the shop working to capacity long after many other railroad shops had been compelled to make substantial reductions in forces.

Not a New Design

In general, no new features were incorporated in the design of these Mikados which are of relatively light weight intended for use on divisions where not enough





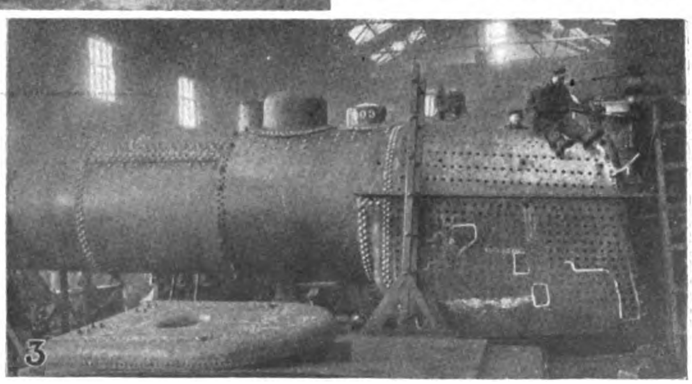
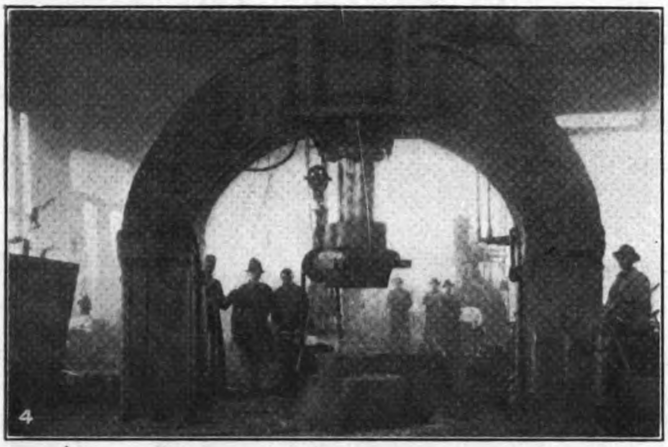
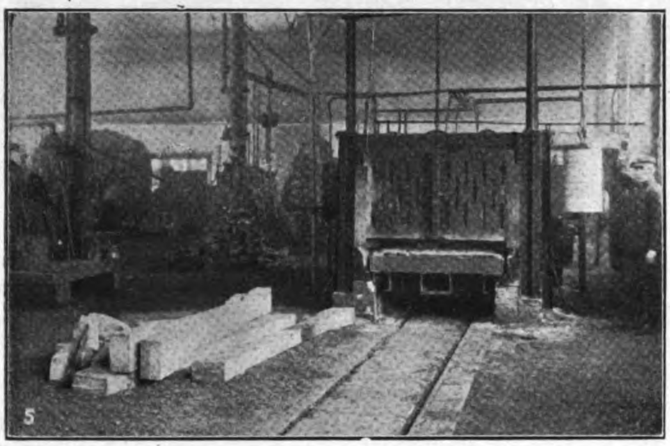
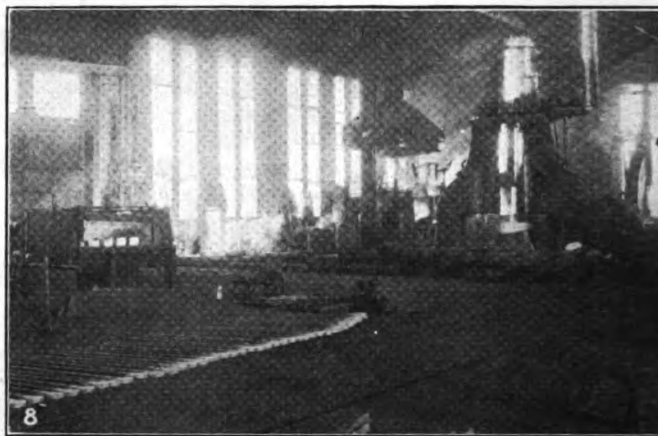
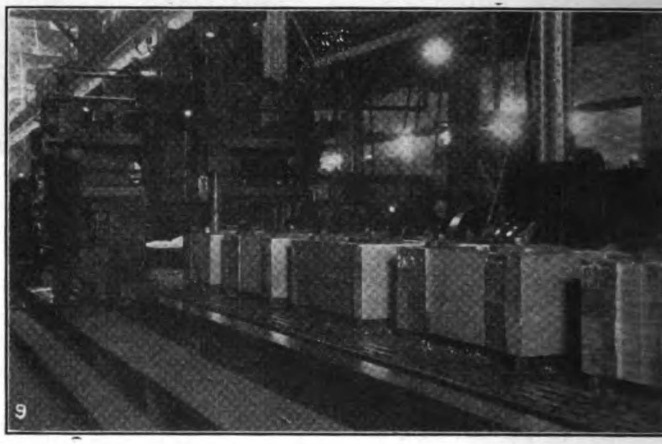


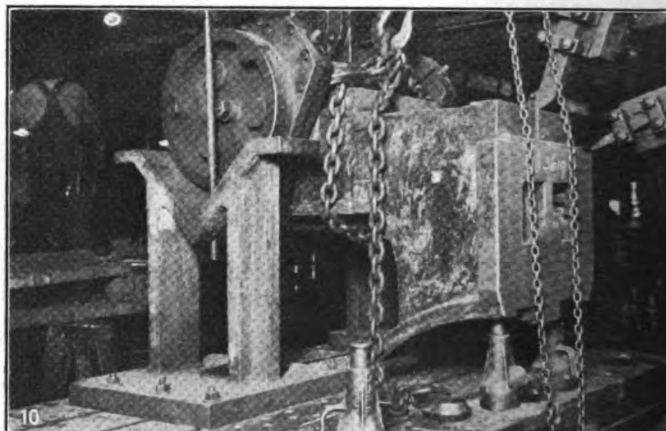
Fig. 1—Nicholson Thermic Syphons Applied to Fire Box; Fig. 2—Syphon Connections to Crown Sheet and O'Connor Flanged Door Sheet; Fig. 3—Reaming for Back Boiler Head Rivets











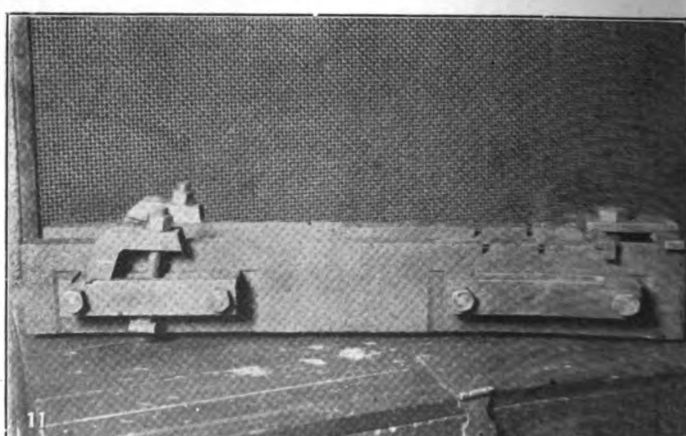


Fig. 4—Chambersburg Five Ton Hammer Forging Rod Section; Fig. 5—Rods Ready for Annealing in a De Remer-Blatchford Car Bottom Type Furnace; Fig. 6—Difficult Forging Job—950 Lb. Trailer Radius Bar; Fig. 7—Forging Back Section of the Trailer Radius Bar; Fig. 8—Spring Hangers Forged in Five-Inch Acme Forging Machine; Fig. 9—Machining Four Frames at One Setting on a Seller's Double Head Frame Slotter; Fig. 10—Cylinder V-Blocks and Chucks (Slide Valve Cylinder Shown); Fig. 11—Chuck for Holding Shoes and Wedges While Milling.

tonnage develops to warrant using heavy big I. C. Mikados. The principal dimensions, weights, etc., of the new locomotives are shown in the table.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Illinois Central
Type	2-8-2
Service	Freight
Cylinders, diameter and stroke	25 in. by 30 in.
Valve gear, type	Baker
Valves, piston type, size	14 in.
Weights in working order:	
On drivers	220,450 lb.
On front truck	25,250 lb.
On trailing truck	42,000 lb.
Total, engine	287,700 lb.
Tender	145,000 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total, engine	34 ft. 9 in.
Total engine and tender	63 ft. 7 11/16 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	30 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main	10½ in. by 12 in.
Driving, others	9 in. by 12 in.
Front truck	6 in. by 10 in.
Trailing truck	8 in. by 14 in.
Boiler:	
Steam pressure	185 lb.
Diameter first ring, outside	79½ in.
Firebox, length and width	110 in. by 72 in.
Tubes, number and diameter	234—2 in.
Flues, number and diameter	34—5⅜ in.
Length over tube sheets	20 ft. 6 in.
Grate area	55 sq. ft.
Heating surfaces:	
Firebox	208 sq. ft.
Arch tubes	14 sq. ft.
Tubes and flues	3,492 sq. ft.
Syphon	59 sq. ft.
Total	3,773 sq. ft.
Superheating	810 sq. ft.
Combined evaporative and heating	4,583 sq. ft.
Tender:	
Style	Water bottom
Water capacity	7,000 gal.
Fuel capacity	15 tons.
General data estimated:	
Rated tractive force, 85 per cent	46,800 lb.
Factor of adhesion	4.71

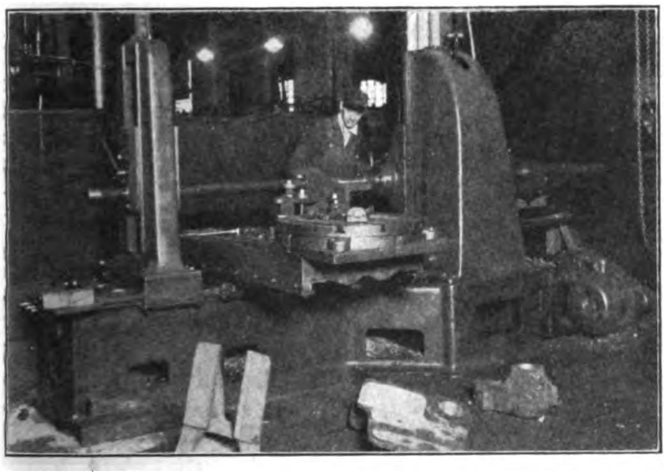


Fig. 12—Machining Driver Brake Fulcrum Castings on a Lucas No. 32 Horizontal Boring Machine

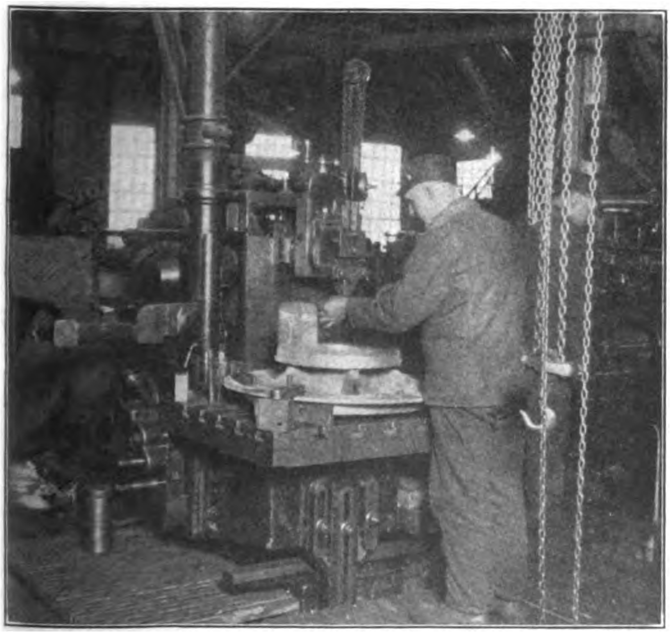


Fig. 13—A Morton Drawcut Shaper Comes in Handy for an Awkward Short Planing Job on the Back Cylinder Head

Among the accessories used on these locomotives may be mentioned superheaters, Nicholson thermic syphons, Baker valve gears, Ragonnet power reverse gears, Hodges trailing trucks, No. 5 New York air compressors and Buda electric headlights. The locomotives have proved very satisfactory in service, reports from the road men being to the effect that they are free steamers, easy to handle and quick to get up speed. Probably one reason for the last feature was the care given in designing the cylinders to reduce mechanical clearance to a minimum and make all ports straight or with as smooth curves as possible. With this end in view the ports were laid out full size on boards and all changes checked by the pattern maker for core position and wall thickness.

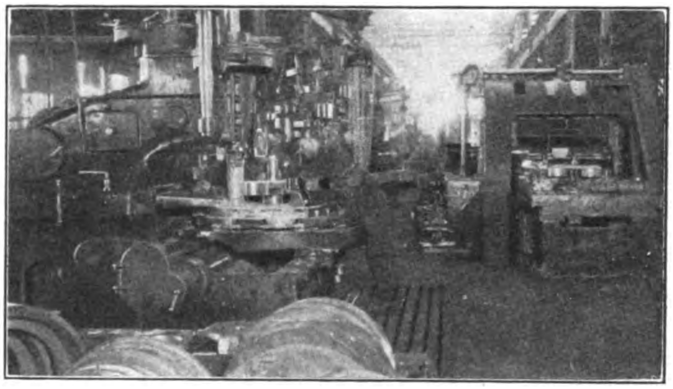


Fig. 14—Powerful Ingersoll Vertical and Slab Millers Recently Installed for Heavy Rod Work

The whole boiler back ends were made identical with those of the large I. C. Pacific type locomotives, a feature which will be of importance when it comes to renewing tube sheets and fireboxes. In general, details such as guides, crossheads, trucks, etc., were made like those on the large Mikados to avoid introducing another standard.

Boiler Shop Work

In preparation for handling the boiler work new flange sheet dies had to be made and these were cast by the American Brake Shoe and Foundry Company from patterns made at Burnside. These dies were used in a 450-ton Niles-Bement-Pond hydraulic press for flanging all back heads, back flue sheets, door sheets and throat sheets. Circular depressions in the back tube sheets to take care of expansion of the Thermic syphons were formed at the same time. These are shown in Fig. 1 and obviate the welding in of diaphragm plates as called for in the Locomotive Firebox Company's drawings. The O'Connor flanged door sheet hole is plainly shown in Fig. 2 which also gives a good idea of the way the syphon is stayed and connected to the crown sheet. Both syphon connections to the firebox were acetylene welded.

All tube sheet holes, staybolt and stud holes were punched and when necessary drilled before the flanging operation with a great saving in layout time, one set of sheets being used as templates for the others. In addition, this method

gave the certainty of accuracy since subsequent sheets were not punched until the first boiler was found to go together correctly. The tube sheet holes were punched 1⅛ in. and drilled 1 15/16 in. for tubes and 4⅝ in. for superheater flues. Another feature was the use of copper ferrules ⅜ in. longer than the sheet thickness and this unusual length made the ferrules hug the tubes after expanding and prevented the formation of a corner in which scale can accumulate and cause the tubes to burn off.

Owing to insufficient furnace height the main steam domes could not be made at Burnside and were purchased from the locomotive works. The mudrings were of cast steel from the American Steel Foundries. Type U. W. Flannery staybolt sleeves were electric welded to the casting sheets.

It was particularly fortunate for the rapid progress of the boiler work that practically all of the experienced boilermakers at Burnside who went out on strike in 1922 returned and these men were organized into three shifts for drilling, two shifts for reaming and riveting, and one shift for fitting up. As much as possible of the heavy riveting was done on an 18-ft. Niles-Bement-Pond bull riveter. The work of reaming for back head boiler rivets is shown in Fig. 3.

Tenders

The old 811 class tenders were rebuilt so as to be almost entirely new except for frames and trucks. The shape of the coal pit was changed and a coal rack applied to increase the fuel capacity to 15 tons.

Blacksmith Shop Work

Rods for the new locomotives were forged under one of the largest, if not the largest, railroad shop steam hammers in the Chicago district—the 5-ton Chambersburg hammer illustrated in Fig. 4. Billets 7 in. by 15 in. by 72 in. were used, making either one main rod, or one back rod and a strap. The main, intermediate, back and front rods weighed, rough forged, 400 lb., 665 lb., 480 lb., and 480 lb., respectively.

All rods were very carefully annealed by heating to 1,450 deg. F., and allowing them to cool in the furnace with the door closed, taking about 16 hours. The furnace used, illustrated in Fig. 5, is well adapted for this work because the car bottom greatly facilitates loading and unloading. A sand seal at the edges of the car bottom prevents flames going under and warping the wheels and plates. Another interesting feature of this furnace, which is made by the DeRemer-Blatchford Company, Chicago, is the provision of complete temperature indicating equipment. A pyrometer with six thermo couples suitably located at different points in the furnace enables differences in temperature to be detected and corrected. A tackle or winch is used to move the car bottom in and out of the furnace.

One of the largest and most difficult forgings was the front section of the trailer radius bar illustrated in Fig. 6. This weighed 960 lb. and was forged in two pieces, which were welded through the 10-in. hole. Straps were placed across the ends and a Porter bar with counterbalance weights made it possible to handle the two awkward parts while welding. The back section of the trailer radius bar weighing 800 lb. is shown partially forged in Fig. 7. Here a swinging ram is being used to make one of the right angle bends in the bar.

Spring hangers, forged at one end and ready for the operation to be repeated at the other end, are shown in Fig. 8. This work, together with a great deal of other work on brake rigging, smoke arch braces, guide yoke braces and pins of all sorts, was done in the forging machines at Burnside.

Machine Shop Work

About 583 men were employed at the Burnside machine shop to perform machine operations on the various castings and parts of the new locomotives as well as other locomotives which were going through the shop for light and heavy repairs. The pressure of the work on many of the machines was so great as to require the organization of two and in some cases three shifts and this arrangement enabled most of the machine parts to be furnished on time except in a few cases where lack of material caused a delay.

While several new machine tools were installed previous to and during the time the new locomotives were under construction, most of these were essentially replacements and only one machine was purchased directly as a result of undertaking the new work. This was a heavy Barrett double bar machine, especially designed for boring cylinders and saving a great amount of time on this operation owing to the fact that both the cylinder and valve chamber are bored at the same time. The cylinder facing operation is also performed on this machine. On a 28½-in. by 40-in. Mikado locomotive cylinder the barrel can be bored in one cut, using five tools in the holder, and faced in five hours. After the cylinder bushing is applied the cylinder is replaced in the machine for boring the piston fit and finish faced in 12 hours. The size of the valve chamber on this class of cylinder is 18 in.

In addition to the Barrett cylinder boring machine the following new machines were installed recently at Burnside largely as replacements of worn out tools: One Bullard 54-in. vertical turret lathe; one Lucas No. 32 horizontal boring machine; one Ingersoll vertical rod milling machine;

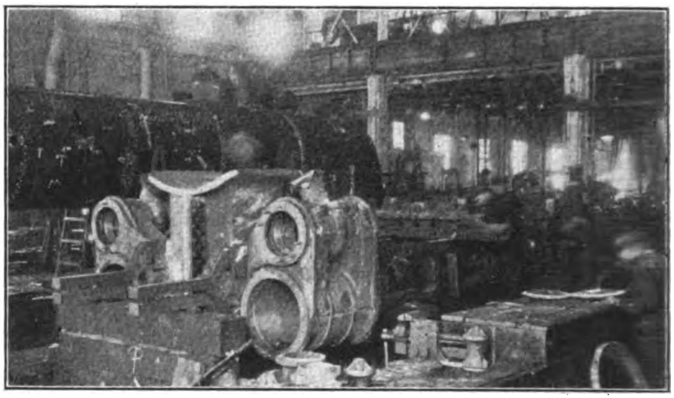


Fig. 15—Assembling Operations in the Erecting Shop

one Ingersoll horizontal slab milling machine; two Morton draw-cut shapers; one Diamond guide grinder and magnetic chuck.

Many jigs and devices were developed to expedite the work and so far as possible to standardize it. For example, a complete set of standard gages for crank pin sizes and pin fits in wheel centers was made, thus saving a considerable proportion of the time which would have been required for individual fits.

Cast steel frames purchased from the American Steel Foundries were machined four at a time on the Sellers double head frame slotter as indicated in Fig. 9. This is a good example of the way machine operations were combined whenever possible with an important reduction in cost and time required for the operation.

The V-blocks and chucks shown in Fig. 10 were an important aid in holding the cylinders in correct alinement for planing. (The cylinder shown is a slide valve type and not the piston valve cylinder used on the new Mikado locomotives.) The construction and use of this jig is readily apparent from the illustration, the V-blocks being held in accurate alinement with the planer bed by suitable keys in the T-slots. The chucks are held central with the cylinder bore by universal jaws and with a long bolt between the two chucks for greater security. It is obvious that with the chucks resting on the V-blocks as shown the cylinder can

be revolved to any angle required for planing with the assurance that the cylinder center line will always be parallel with the planer bed. A great amount of set-up time is saved and the accuracy of the work increased by this device which was adapted from drawings furnished by the Lima Locomotive Works.

Brass shoes and wedges were used on the new locomotives and an interesting chuck holding them while milling is shown at Fig. 11. The notches at the right are to accommodate shoes of different lengths and it is obvious that the dogs at the left can be so applied as to hold each shoe down to the chuck and against lateral movement while being milled for both the driving box and frame fits with a combination four section milling cutter. The new dogs are made narrower than the flange thickness of the shoes so that the milling cutters will pass by them.

One of the most flexible machine tools used on the new locomotive work was the Lucas No. 32 horizontal boring machine illustrated in Fig. 12. The illustration shows the operation of boring a driver brake fulcrum casting and this and many other irregular parts can be set up with ease and bored, or in some cases turned, on this machine. Back valve heads were bored for the valve stem and faced on the Lucas boring machine in two hours.

For many short planing and shaping operations the Morton drawcut shapers did effective work. One of the new shapers is shown in Fig. 13 finishing the guide bearing on a back cylinder head. The turning operations on this cylinder head were performed on the new Bullard 54-in. vertical turret lathe, of which a photograph is not available. This machine was a real factor in speeding up the machine work on many different parts used on the new locomotive. The ease of setup, power and flexibility, together with the possibility of bringing different cutting tools quickly into action, made this machine an important factor in clearing up a congested machine shop floor and keeping the parts moving. The back cylinder head, shown on the shaper in Fig. 13, was machined complete, except for the planing, on the 54-in. Bullard vertical turret lathe in seven hours. The front head was finished in three hours. The Ingersoll vertical and slab millers, illustrated in Fig. 14 are shown machining rods for the new Mikados and were a material help in getting these rods out on time.

Erecting Shop Work

Work in the erecting shop (Fig. 15) was systematized as much as possible and extra shifts put on such jobs as could be worked to advantage in that way. While in the aggregate a tremendous number of operations must be completed in the erecting shop to assemble 24 new locomotives, and some of this work, particularly that relating to the lining of cylinders, frames, shoes and wedges, erecting valve gears and setting the valves, must be extremely accurate, there was nothing particularly new in the way this work was handled for the new locomotives at Burnside. Great credit is due none the less to the erecting shop forces for their thorough and careful work, of which the performance of the new locomotives in service is ample testimony.

The photographs and data presented in this article are made available through the courtesy of R. W. Bell, general superintendent of motive power of the Illinois Central, and L. A. North, shop superintendent at Burnside, who with the shop foreman rendered valuable assistance in gathering the information and taking the photographs.

Standardization of Chisel Production

A Comparison of the Relative Merits of Tempering Methods and the Various Kinds of Steel

By Major Johnstone-Taylor

It is not usual in these days of machining to limit gages to find much information disseminated on the subject of hand tools. Yet, despite the modern methods of machine shop, the hand worker still remains and the chisel is still an important hand tool. Henry Fowler, chief engineer of the Midland Railway, recently made public the methods employed at the Derby, England, shops. The publication of this information led another large works, W. H. Allen, Sons & Co., Ltd., Bedford, into stating their views as well as making a number of tests as to the relative merits of the two methods.

It must be remembered that although the analysis of a steel may be excellent, its manipulation in hardening and tempering needs experience. Even in making chisels, a good workman can often spoil a piece of good steel.

In many shops, after making the chisel, the old method is still used by the blacksmith of heating it red hot and then dipping the end into cold water to harden it and letting the heat run down from the shank to the hardened edge.

This system has admittedly some advantages. It certainly insures the cutting edge being the hardest part of the tool and eliminates any clearly defined hard and soft point, but, of course, the method is wholly a rule of thumb and depends upon the skill and judgment of the operator. There is a tendency, however, to heat the steel too rapidly and uniform tempering is very difficult to obtain. Moreover, with only the edge hard, the life of the chisel is short on account of the fact that when the cutting edge becomes dull or chipped, the back is too soft to grind again for further use.

Tests Uphold the Old Methods

It is interesting to note that W. H. Allen, Sons & Co., Ltd., still adhere to what many would regard as rule of thumb methods. The steel used by this company is .825 carbon steel and in the manufacture of chisels, it has been using the following practice. After drawing out and allowing the chisel to cool, it is heated at the point to a bright red, 1,562 deg. F., for a distance of about 1 in. It is then quenched in cold water for a distance of 3/8 to 1/2 in. from the end. The end is then taken out of the water and the hardened point is tempered by the heat conducted from the unquenched portion. As soon as the cutting edge has reached purple or deep blue, 536-605 deg. F., the whole tool is again quenched.

This treatment is found to give a point of maximum hardness and a decreasing hardness from the point upwards, because the chisel is of the thinnest section at the point and is chilled the most suddenly in the quenching. The thicker portion beyond the point loses its heat less suddenly. The extreme point is less tempered or "let down" than the rest of the tapering portion and the effect of this gradual decrease in hardness is shown in the curves in Fig. 1. This method, of course, depends largely upon the skill of the operator and

contains a personal factor that present day methods aim at eliminating.

British Railway Shop Practice

Although it might not appear to be a tool of much importance, the actual amount of work done by chisels in the large railway shops is considerable and the attention that is paid to small details is well worth the trouble. However, so far as British practice is concerned, carbon steel of the following analysis has been found to give uniformly good results, provided it is of uniform quality and of the best crucible steel.

The following system is advocated by Henry Fowler and it will be observed that the material used under ordinary circumstances is not alloy steel, but carbon steel of the following standard specifications: Carbon, .75 to .85; manganese, .30; silicon, .10; sulphur, .25, and phosphorus, .25. It might at first be supposed that an alloy steel of some kind would be made use of for making chisels. Dr. Hadfield, a well-known steel expert, has suggested the addition of one per cent chromium to the forgoing analysis, pointed out that the duty of a chisel is to cut into metal under pressure.

Standard Chisel Forms

Chisel forms have been standardized on the Midland Railway and these are shown in Fig. 2. The designation and

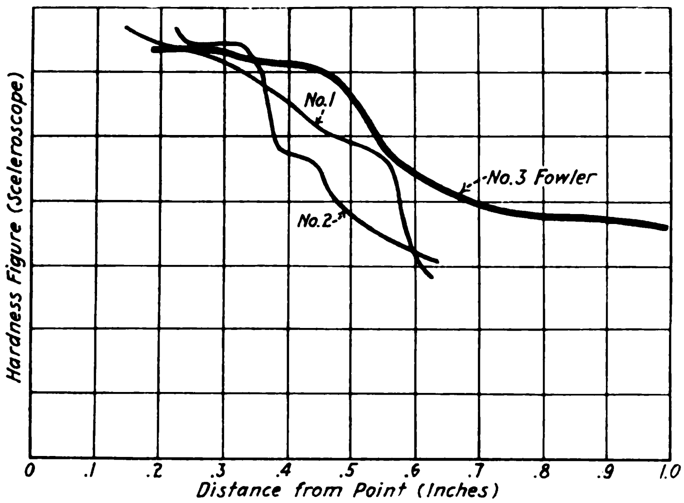


Fig. 1—Curves Showing the Results of Sceleroscope Tests

various uses are as follows: *a,* chisel for heavy brass; *b,* chisel for heavy iron and steel; *c,* chisel for cylinder repair jobs; *d,* side tool; *e,* square nose tool; *f,* diamond point tool; *g,* large cross cut tool; *h,* round nose tool; *j,* gouge tool, and *k,* chisel for chipping large surfaces of babbitt.

Manufacture of Chisels

The procedure followed at the Derby shops in the manufacture of chisels is to make them to stock orders in the smith shop and then forward them to the heat-treating shop for hardening and tempering. The work in this shop is handled in batches of 50 and the aim is to employ a standard system of treatment to eliminate the personal element previously referred to. All chisels are issued from the toolroom stores as required, and there are no grindstones in the shops for the use of the workman.

With the chemical composition of the steel more or less of a constant nature, the chief factor liable to cause a varied temperature is the chisel section. All chisels are carefully heated in a gas fired furnace from 1,345 to 1,365 deg. F., according to the section. When the correct steady temperature is attained, the chisels are quenched in water to a depth of 3/8 in. to 1/2 in. from the point. The period of quenching depends upon the size of the section. The chisel end is thoroughly chilled in the water, after which the whole tool is immersed and cooled off in a tank containing linseed oil. The oil tank is water cooled and after this treatment the chisels have a dead hard point and a tough sorbitic shaft.

The tempering of the point, or "letting down," is done by immersion in another oil bath, the temperature of which is raised to 420 deg. F. The first result is, of course, to drop

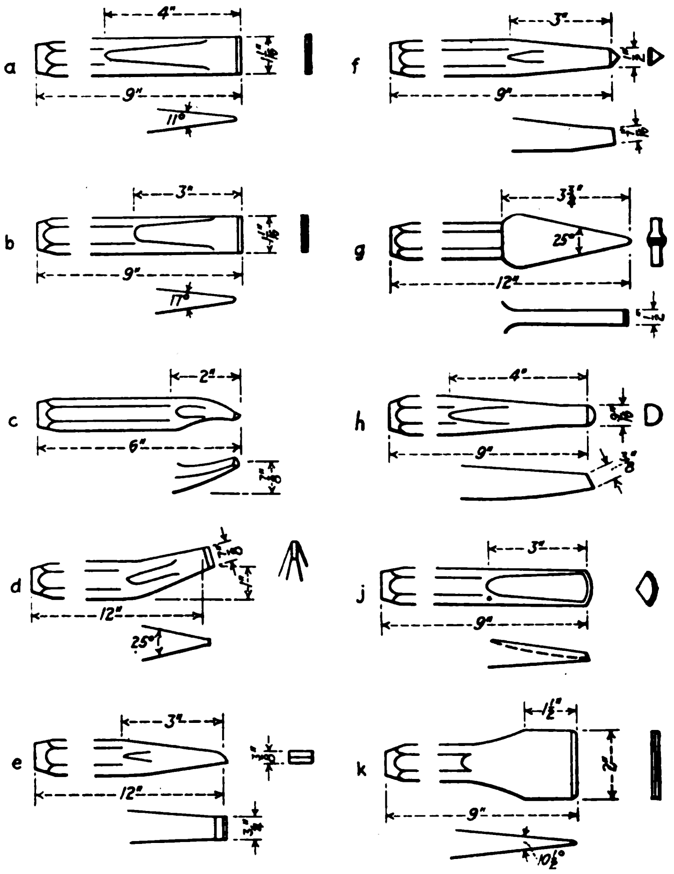


Fig. 2—Standard Chisel Forms Used on the Midland Railway

the temperature of the oil, which is gradually raised to its initial point. On approaching this temperature, the chisels are taken out at every 3 or 4 deg. of temperature rise and tested with a file. When the desired temper has been reached (about 430 deg. F.), the chisels are withdrawn, cleaned in sawdust and permitted to cool in an iron tray.

The Two Systems Compared

For the purpose of comparison, four chisels of the same dimensions, the shape and size, as shown in Fig. 3, were

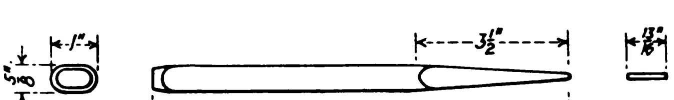


Fig. 3—Size and Shape of the Chisels Used in the Tests

tested at Bedford. Two were dealt with by the first method outlined and two were tested by the method as advocated by Mr. Fowler.

In carrying out this treatment the quenching of the point was carried to 1,364 deg. F., while in tempering, one of the chisels was left in the oil bath for 10 min. and the second for 15 min. The tempering was again carried out through a range of temperature that depended upon the amount of fall in temperature of the bath below 420 deg. F.,

the fall in the temperature being caused by adding cold chisels. The length of time taken in tempering had a considerable effect. For example, the same temper was obtained by a long exposure to a comparatively low temperature, as by a shorter exposure to a higher temperature. The chisels were subsequently tested by a sceleroscope and the results were plotted as shown in Fig. 1.

From these results, it was observed that there was very little difference as regards the hardness of the extreme edge of the tool. But there was a more rapid falling off in the hardness along the tapering portion, than with the Fowler system. In the latter, there was a uniform tempering of all the hardened portion, but to a less extent than by the Bedford system. While by the Fowler method, any decrease of hardness that took place over the quenched and tempered portion was entirely due to a difference in the rapidity of quenching caused by the increasing thickness.

Three of the chisels were put to practical use at the hands of an operator, who was not aware of their difference. The work performed was cutting hard steel on the flat. This put the chisels to a fairly hard test. Two of the chisels made by the Bedford system chipped slightly, and the third, made by the Fowler system, broke wholly away at the edge.

This test, however, cannot be taken as a conclusive one, but the following conclusions were arrived at by the experimenters in respect to the Fowler system: First, that it gave a somewhat brittle working point; second, it produced a chisel that permitted more grinding of the point without rehardening; third, it produces chisels of dependable quality in large numbers; fourth, the tough shaft has no proved advantage, and, fifth, it is more costly than the older methods.

Summing up the whole matter, therefore, the second and third advantages would appear to justify organized methods of production in shops where from the nature of the work, a large number of chisels are in constant use.

Device for Testing Pneumatic Motors

By E. A. Murray

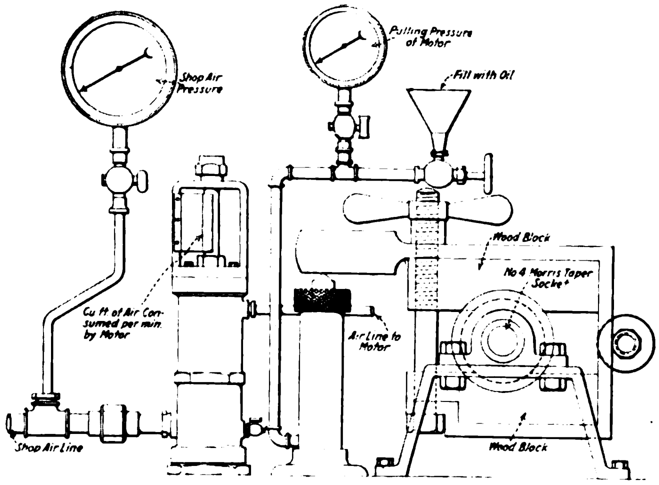
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

It is essential that pneumatic motors be kept in first class condition in order to get effective performance. To determine the condition of such tools, this shop has put in a testing device that has worked very well.

This device operates in the following manner: Air is conducted to the "toolometer" from a full, free air pipe. This "toolometer" is for a ¾-in. standard pipe and registers the amount of free air that passes through it. This is necessary as the manufacturers usually give the free air consumption in connection with the rating of different air motors. A standard air gage is attached to the pipe just before it enters the "toolometer" to give the correct air pressure in the shop lines. An air hose is connected to the air pipe after it has traveled through the "toolometer" and the open end of the hose is then connected with the air motor to be tested. The spindles are arranged for Morse taper shanks. An arbor is made with the Morse taper shank on both ends, one to fit an air motor and the other a Prony brake. The spindle fits a Morse taper up to No. 4 size.

The Prony brake is arranged with a roller between the bearings and wood clamps. The roller is attached by means of a screw passing through straps that encase the wood. The end of upper strap projects out far enough to have a bearing on the 1½-in. plunger, which has a lift of 3 in. Some good oil is run into the cavity after the plunger has been lifted to its highest point.

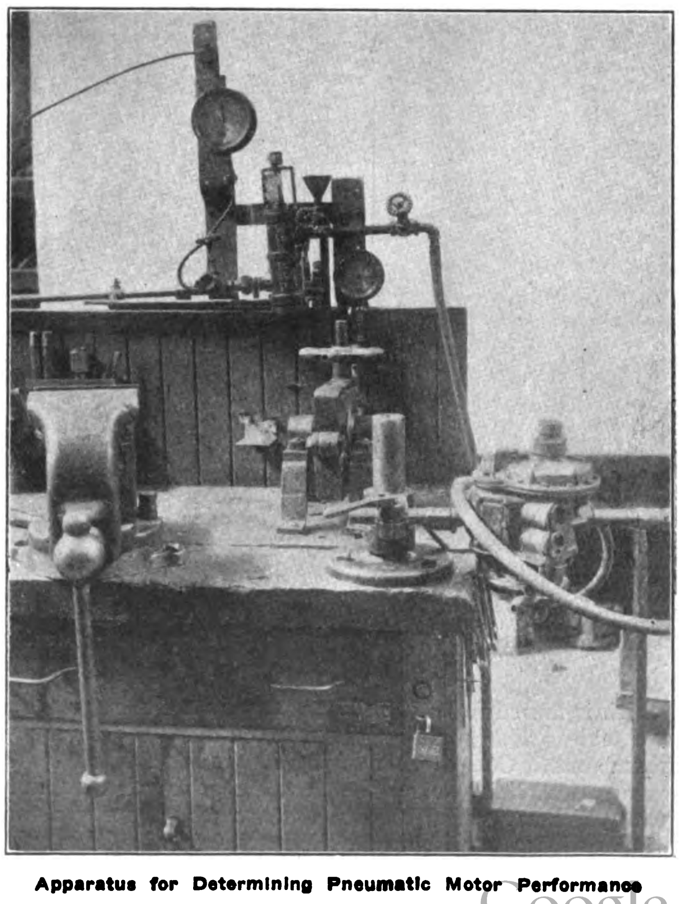
The motor attached to the Prony brake is started and after full speed is attained, the hand wheel which closes the wood clamps on the roller, is screwed down. The friction between the wood clamps and the roller causes the straps to bear down on the plunger and this brings a pressure on the small air gage attached to the plunger. Pressure on the brake is increased until the air motor is finally stalled under full air pressure. Records are made from the gages as soon as this occurs; first the air pressure in the shop line; second, the number of feet of free air passing through the "toolometer," and third, the number of pounds pull as registered on the gage connected with the plunger.



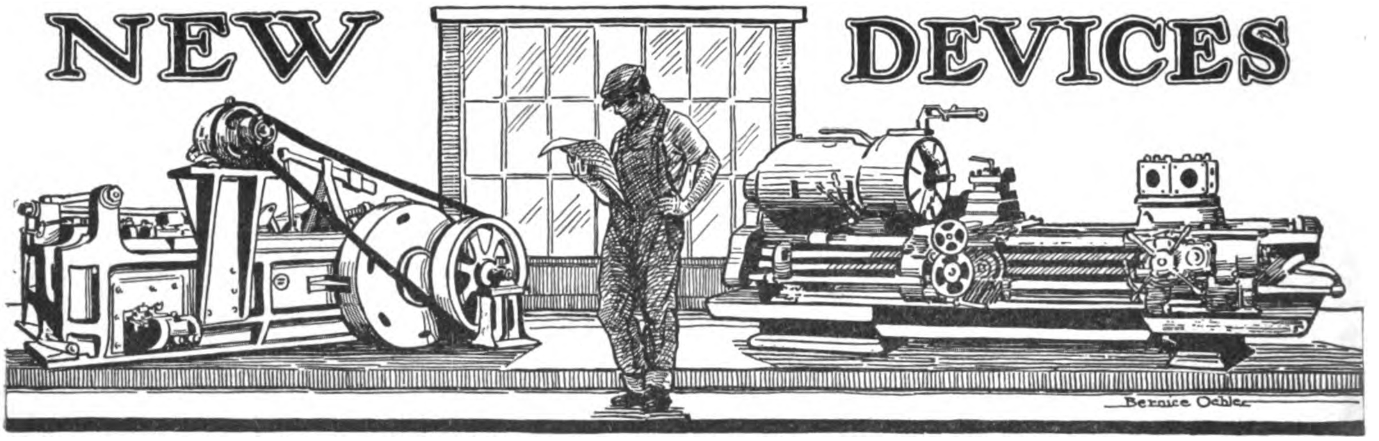
Arrangement of Apparatus for Testing Pneumatic Motors

This test is made on each new air motor, according to the classification, as it is placed in commission. If these motors or any others come in for repairs or complaint concerning the power developed, they are placed on the test rack to get a record showing what this class of motor should do.

As a last resort, the motor is placed under a steel yoke attached to the work bench and a practical test is run to determine just what size hole the motor will drill.



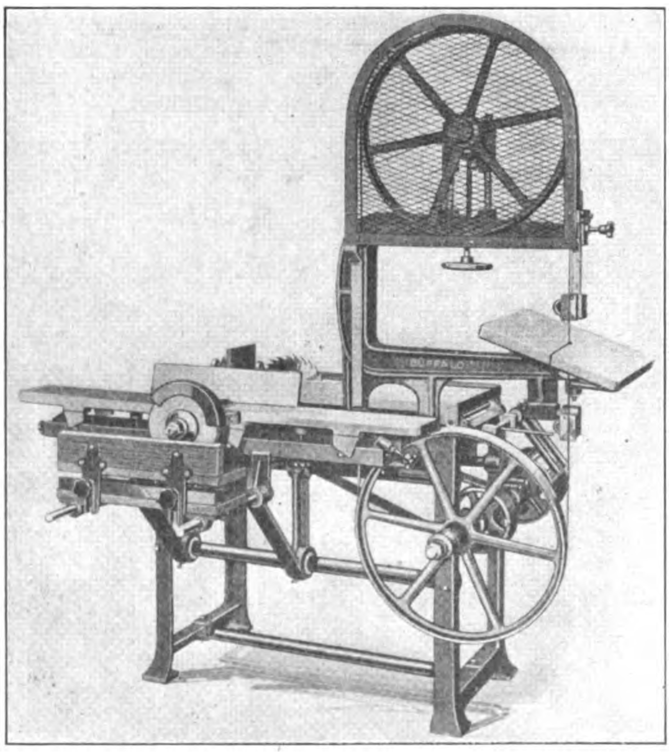
Apparatus for Determining Pneumatic Motor Performance



Combination Woodworker

SOME improved features have been added to the No. 2 combination woodworker manufactured by the Buffalo Forge Company, Buffalo, N. Y. Among the most important is a change in the planer guide arrangement providing for quicker, simpler and more accurate adjustment, and the introduction of a positive drive for a rip saw and jointer mandrel, obtained by means of a rawhide pinion and gear.

The new planer guide arrangement consists of a slide which is moved forward and backward in a slot or groove in the table. The guide is locked in position by means of a thumb nut. Considerable saving in time is effected by the greater simplicity and more accurate adjustment obtained with this arrangement over the older method of using a two-screw adjustment without the slide arrangement. This guide can also be set at any angle desired for beveling purposes.


Woodworker with a Positive Drive Rip Saw and Jointer Mandrel

In the old type No. 2 woodworker, the pulley on the drive shaft was belted directly to a pulley on the jointer and circular saw shaft and the belt was twisted in order to obtain the desired direction of rotation. This method of drive has been replaced in the new woodworker by a positive drive of the pinion and gear pulley type, which makes a smoother running machine and eliminates belt slippage. The gear ratio of the two pinions is approximately two to one. The pulley pinion is cast in one piece, while the main shaft pinion is keyed to the shaft.

The machine is equipped with tight and loose pulleys, 8 in. by 3 in. in size, and with a handy belt shifter. The drive shaft is 1 in. in diameter and runs in 4 in. babbitted and reamed bearings, split for adjustment. In addition, the pulley for the jointer and the lower band saw wheel are also connected to this shaft by means of jaw clutches. This means that different parts of the machine may be run independently of each other with a resulting saving in power and wear on the bearings.

The table for the cross-cut saw and rip saw is 37 in. long by 15 in. wide and is made of heavily ribbed cast iron. The saw mandrel is 1 1/16 in. in diameter and runs in babbitted and reamed bearings 4¾ in. long and is provided with oil grooves. The saw, 10 in. in diameter, is driven at a speed of 3,000 r.p.m. The table is hinged at one end and can be raised or lowered to adjust the depth of the cut. A cast-iron cross cut guide is also furnished with this machine, which slides in a milled groove in the table and is adjustable for varying angles. The saw is capable of making a cut 2¾ in. deep.

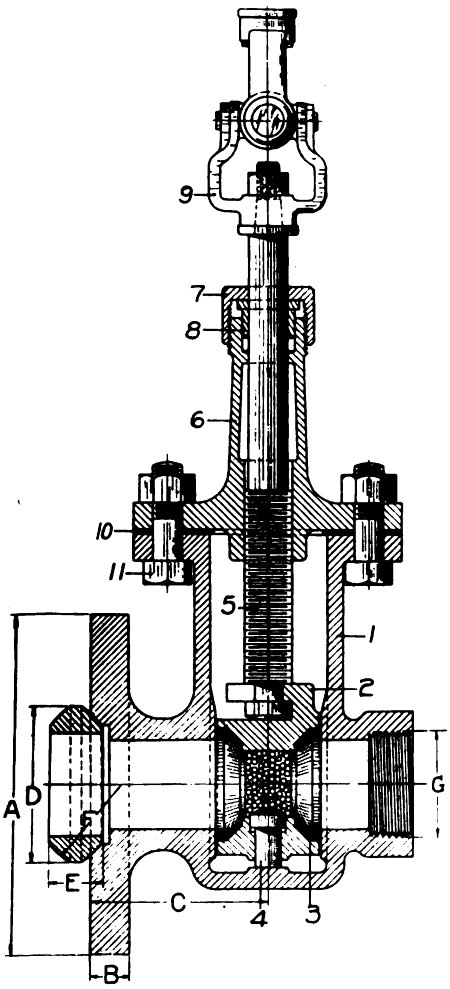
The jointer, fastened on the same spindle as the saw, is 6 in. long and 3 in. in diameter. A screw and handwheel arrangement is used to make both sides of the jointer table adjustable. These tables are 6 in. wide and 24 in. long, which permits more accurate work than was possible with the former model. The jointer shaft has an outboard bearing and outside of this an 8-in. by ¾-in. emery wheel may be attached when desired by means of the two collars and the nut furnished for the purpose.

A ½-in. reamed hole in the shaft end and a tap for a headless set screw allows straight shank bits to be inserted. In order to facilitate the holding of work to be drilled, a slide table is provided which is readily adjustable to different heights. An 18-in. disk sander may be placed on the lower bandsaw shaft. The bandsaw wheels are 22 in. in diameter by 1½ in. face and are covered by an endless rubber band which reduces slippage of the saw and heat from the blades.

Compensated Blow-Off Valve

THE Nathan Manufacturing Company, New York, has developed a new type of compensated blow-off valve which is claimed to provide a permanently tight fit on the seat and to practically eliminate repairs and replacements. It does not depend on the action of steam or fluid pressure to keep it tight.

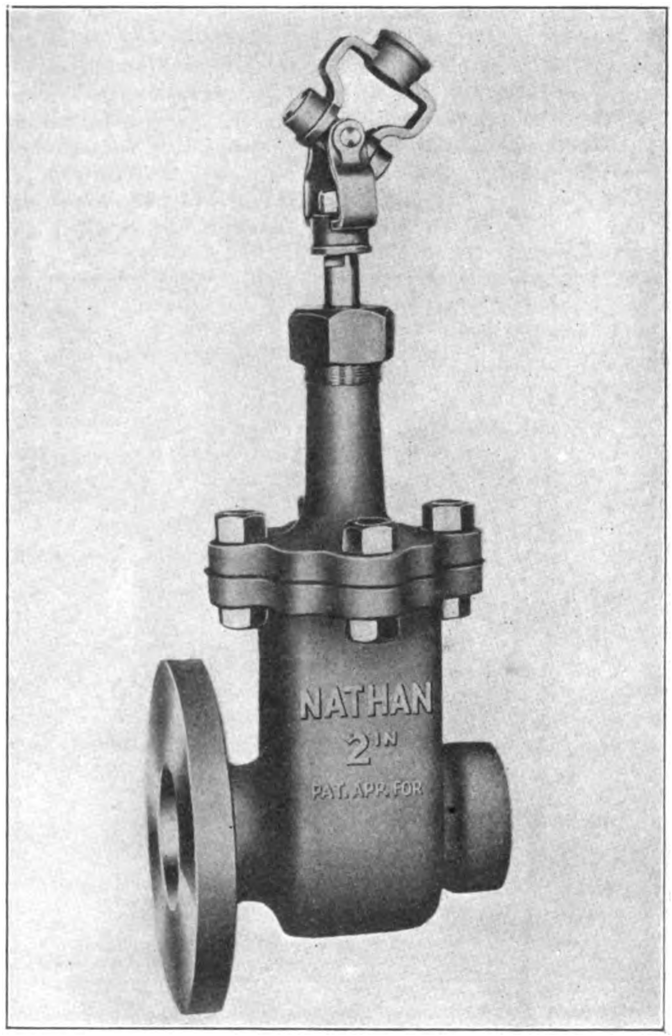
The valve is opened and closed in the same manner as the ordinary gate valve. Instead of a wedge action, however, the valve disks are forced outward against their seats by a uniform pressure produced by small balls or shot, made of non-corrosive steel. The action of the shot within the cage between the valve disks is similar to the action of a fluid and a uniform pressure is exerted over the faces of the disks regardless of their inclination or shape. Referring to the sectional drawing, the steel balls are placed in the cavity of the carrier, 2, within the body of the valve. This carrier also supports the two valve disks. It is raised and lowered by means of the valve spindle, 5, which is threaded into the cap of the valve, 6. At the bottom of the carrier is a pressure knob or plunger, 4, which is forced into the cavity containing the balls when the carrier reaches a point near the bottom of its travel. When this plunger pushes upward, it displaces the balls, producing a uniform pressure between the disks. In this way the disks are forced against their seats regardless of any wear that may have occurred.



Sectional View of Nathan Blow-off Valve

It is claimed that the valve will remain tight whether the valve disk seats are inclined to the right or to the left, upward or downward, and even if the angle is different on the two faces.

The valve is built with threaded ends or with a flange connection at one side, as illustrated. Its construction throughout is simple and any part may be easily replaced. The outlet of the valve is tapped for the attachment of pipe and hose and when fully open, the carrier and the disks are raised into a space within the body of the valve, forming an unrestricted passage for the discharge. Because of the discharge across the opening, it is claimed that scale will be washed through the valve, but that should any remain in the bottom of the valve, it can not interfere with the closing of the valve or with the forcing of the disks tightly against their seats.



View of Nathan 2-Inch Blow-off Valve

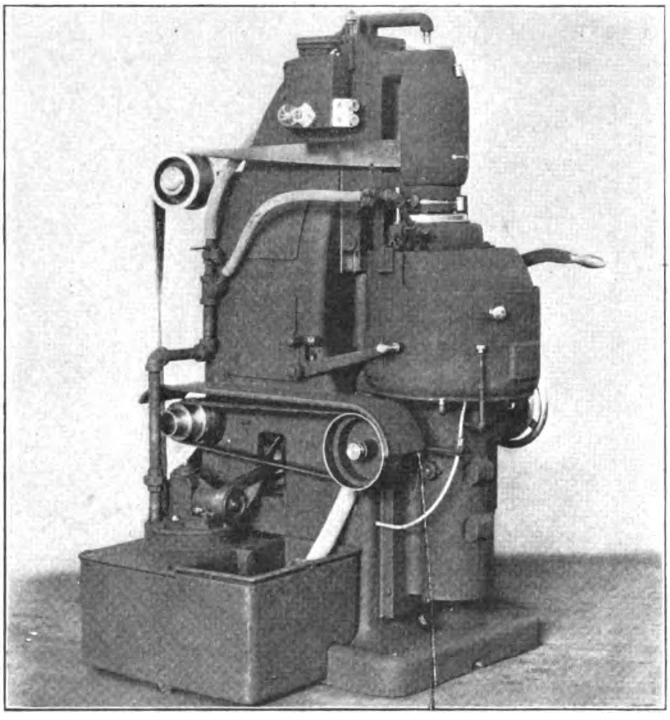
The tightness of the valve is independent of the action of the steam or other fluid and depends merely on the force with which the plunger or pressure knob is driven in the shot-filled cavity. The universal joint at the top of the spindle is furnished when it is desired to control the blow-off valve from the cab or the running boards, but a handle may be supplied if the location of the valve is such that an extension is not needed.

Single Stroke Surface Grinding Machine

A SINGLE stroke surface grinding machine with a working range of 12 in. in diameter and a height of 7 in. under an unworn grinding wheel has recently been developed by the O. S. Walker Company, Inc., Worcester, Mass. The grinding wheel is cup-shaped, 8 in. outside diameter, with a 5½-in. hole, is 3 in. deep, and has a rim ⅝ in. thick. Two mounted wheels, suitable for steel and cast iron respectively, are furnished with the machine. The grinding wheel is centered in a cast iron ring and clamped by a bronze ring and four screws. The changing of grinding wheels is easily accomplished by attaching the wheel mounting to the spindle face plate with screws.

A diamond set in a bronze holder is furnished for use when a new wheel is put in service, and also for use in truing the wheel when an exceptionally fine finish is desired. The completed wheel head weighs about 300 lb. and is accurately counterbalanced, the counterweight sheave being carried on ball bearings. The slide has two flat bearings 24 in. in length, which rest on bearing surfaces of equal length on the face of the column. The direction of travel is controlled by a dovetail construction equipped with a taper gib for taking up the wear. The movement of the wheel head is controlled by a hand-operated lever on the right side of the machine.

The spindle is made of steel and carries on the lower end a face plate to which the wheel mounting is attached. A ⅞-in. hole through the center of the spindle provides for the delivery of water inside the grinding wheel. The upper and lower ends of the spindle are carried in radial thrust ball bearings. Oil throwers are employed to maintain proper lubrication of these bearings.

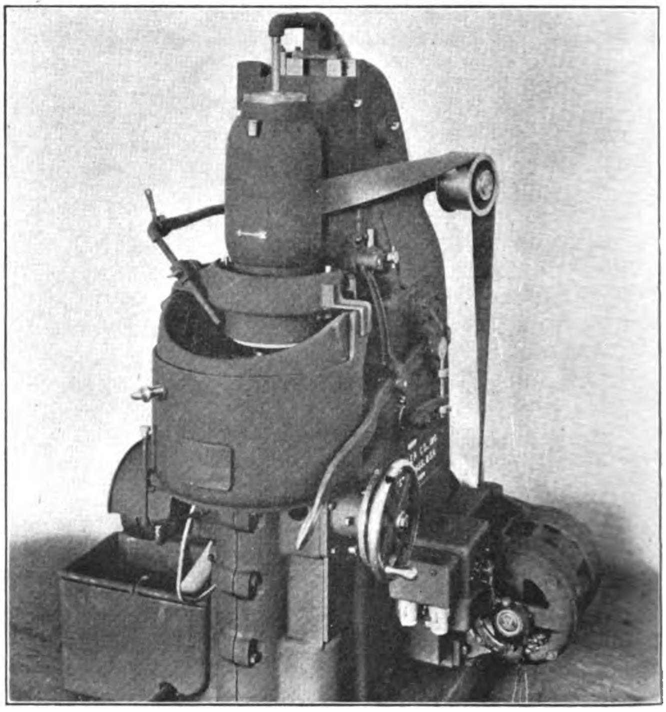


View of Left Side of Surface Grinding Machine, Showing Location of the Water Tank

Compression springs located in the upper spindle housing overcome the combined weight of the wheel spindle, and all revolving parts connected with the spindle. They also maintain the necessary upward thrust of the spindle in the thrust bearing at its lower end, to insure accuracy in grinding.

The wheel spindle pulley is 7¾-in. diameter and is driven by a 3-in. belt running over ball bearing idlers and a 19-in. diameter driving pulley on the main drive countershaft. This countershaft, which is located on the back of the machine, also runs in ball bearings. The face of the wheel spindle pulley is 9¼ in. in width to allow for a maximum travel of 5 in. for the wheel slide. At a speed of 2,200 r.p.m. for the spindle, 10 hp. is available at the grinding wheel.

When arranged for a belt drive, the machine is of the single pulley drive type. The belt from the line shaft runs to a 12-in. diameter, 4¾-in. face pulley, which is carried on ball bearings on the hub of the 19-in. spindle driving pulley. An expanding friction clutch in the hub of the drive pulley serves to start and stop the machine. In the motor-driven machine, the motor is mounted on the side of the column. The drive pulley and clutch are omitted and the machine is driven by means of sprockets and a silent chain. The manufacturer recommends the motor-driven machine to insure constant speed of the grinding wheel. The design of the machine is best adapted for a 7½ hp. motor having a speed of 1,750 r.p.m.



Front View of Surface Grinding Machine with the Guard Dropped Down

The distance to be travelled by the wheel slide is determined by a fixed stop on the column. The vertical movement of the magnetic chuck, through its range of 4 in., is controlled by the elevating hand wheel at the right side of the machine, acting through mitre gears and an elevating screw. A wheel graduated in thousandths and mounted on the shaft carrying the elevating hand wheel, provides for accurate adjustment of the magnetic chuck to compensate for wear of the grinding wheel or for the removal of a predetermined amount of stock from the work. This mechanism has ball bearings throughout.

The magnetic chuck is mounted on a vertical spindle. This spindle is carried in a sleeve 5⅜ in. diameter and has a bearing 15 in. in length in the supporting member. The upper end of the chuck spindle rests in a taper bearing of ample proportions to insure minimum wear and also to maintain permanent and accurate alinement. The lower end of the spindle is carried in a radial ball bearing.

The position of the supporting member on the column is

determined by a large stud projecting from the face of the column. The end of this stud terminates in a ball which engages with a straight reamed hole in the back of the supporting member near the top of the casting. Another stud projects from the face of the column near the bottom and in line with the upper stud. Two thrust screws in the lower end of the supporting member, having their bearing on opposite sides of the lower stud, provide means for adjusting the chuck with reference to the grinding wheel.

The supporting member is attached to the column by three opposing screw supports which constitute a three-point bearing. In combination with the two thrust screws, these supports permit the alinement of the chuck with the grinding wheel, also the adjustment of the chuck for grinding either concave or convex surfaces. The weight of the supporting member, complete with chuck and water pan, is about 750 lb. This is sufficient to eliminate any vibration in the work carrying unit. Rotation of the chuck is controlled automatically through the movement of the wheel slide and also independently by means of a lever placed on the left hand side of the machine in a convenient position.

The magnetic chuck used on this machine is so designed that the number and shape of the poles in the top plate can be arranged to meet special conditions. Water guards are arranged on the chuck in the water pan to protect the chuck and electrical connections against the entrance of moisture.

The electric current is carried to the interior of the chuck through contact rings on the under side of the chuck body, and the lead wires are protected by a flexible metal conduit passing inside the column and up to the demagnetizing switch near the top of the column. The column is a single casting weighing about 1,400 lb. and is designed to provide maximum rigidity.

The water tank is an independent unit at the side of the column and has a capacity of 14 gallons. The pump is of the centrifugal type, ball bearing and driven by a belt from the chuck drive countershaft through the side of the column. A stream is directed upon the chuck through the center of the wheel spindle in such a manner as to deliver a large volume of water inside the grinding wheel. There it is distributed by centrifugal force over the surface being ground. A second stream of water is available outside the wheel. This is for the purpose of cleaning the chuck face in preparation for the next load. The greater portion of grit and chips is caught in two settling pans through which the water passes before reaching the main water tank.

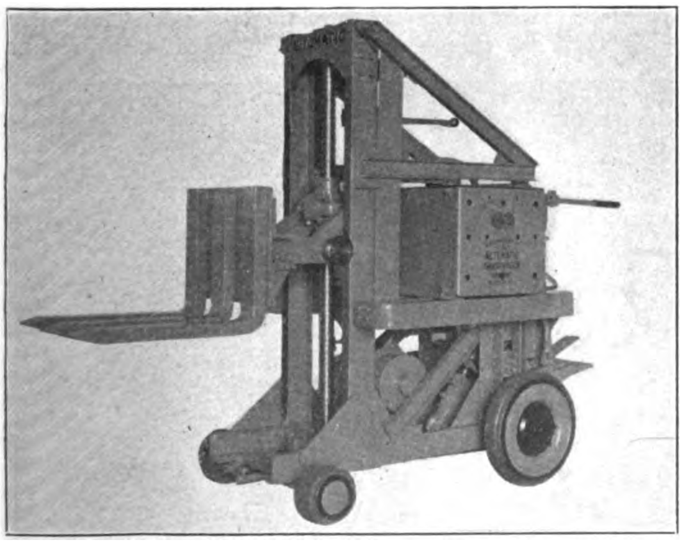
The work to be ground is placed on the rotary magnetic chuck. The lowering of the wheel slide automatically closes the electric circuit through the chuck, operates a clutch which puts the chuck in rotation and brings the grinding wheel in contact with the work. The removal of stock continues until the downward movement of the wheel slide is arrested by a fixed stop provided for that purpose.

When the grinding operation is completed, the raising of the wheel slide automatically stops the chuck rotation, breaks the electric circuit through the chuck and for an instant closes the circuit through the chuck in the opposite direction, thereby demagnetizing the chuck face and facilitating the removal of the work. Work can be put on or removed from the chuck only when the wheel slide is at the upper limit of its travel. With the wheel slide in this position, a fixed guard attached to the water pan fully protects the operator from contact with the grinding wheel.

The position of the chuck can be determined by the thickness of the first piece ground. Further pieces of the same kind can then be ground to the same thickness by lowering the wheel slide the distance permitted by the fixed stop. The only adjustment required is the raising of the magnetic chuck from time to time to compensate for the wear of the grinding wheel.

Automatic Fork Truck

One of the latest developments in the application of electric haulage units to interplant transportation is the fork truck now being manufactured by the Automatic Transportation Company, Buffalo, N. Y. This new type of truck has a number of advantages over previous lift trucks manufactured by this company. It can automatically lift from the floor barrels, boxes, bundles of metal sheets, plates, castings, etc., without the aid of skids. This eliminates a big investment in skid equipment and also conserves floor space.



Electric Truck for Lifting Material with the Forks in Mid-position

The principle of its operation is that the tapered steel forks are designed to slide under the material to be carried, without any kind of assistance. Almost any type of material can be handled by this machine, the only requirement being that the width and length of the forks conform to the width and length of the material to be handled and for this reason the forks are furnished in various sizes to suit the character of the work in the shop where the truck is to be used.

The truck has a lifting capacity of between 3,000 lb. and 4,000 lb. depending on the nature of the material handled, and is built for various lifting heights. In any of the trucks, however, the loads can be started and stopped at any height. The truck is equipped with two motors, one for propelling the truck and the other for elevating. Both motors draw power from the truck battery. The lift is by means of a single oversize screw revolving in a large oversize bronze nut, which is provided with an oil magazine for lubricating the screw. The elevating mechanism is placed below the battery box to afford the best possible protection. The front wheels of the truck have 9-in. by 5-in. rubber tires, and are fitted with Timken bearings to give the greatest mobility with the least friction. This is an important factor to be considered as the entire load is carried over the front wheels. This truck is designed to meet the many demands around a railroad shop for moving and placing heavy castings on machines and for carrying and lifting heavy or bulky material in store houses.

Combination Journal Truing and Axle Lathe

An improved type of combination journal truing and axle lathe has been developed by the Betts Machine Works, Rochester, N. Y. This machine is equipped with two carriages for turning the outside of the journals when the wheels are mounted on the axle. Gaps for swinging the wheels are cut in the bed. These gaps, shown in Fig. 1, have finished surfaces and when it is desired to use the machine as an axle lathe, it is only necessary to insert a filler block in each of these gaps. With the filler blocks inserted, as shown in Fig. 2, the carriages have ample travel

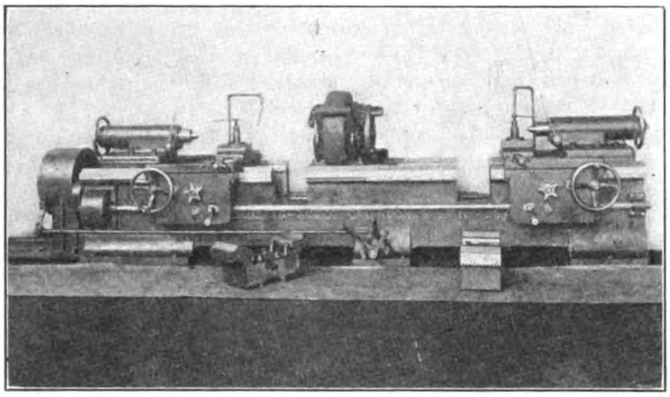


Fig. 1—The Machine Ready to be Used for Turning Journals with the Wheels Mounted on the Axle

for turning both the wheel seat and journal fit, burnishing and also finishing the fillets of the axle.

The center driving head is of the opening type in order to allow axles to be placed, with the wheels mounted, on the centers. The large driving gear is made in two halves with a coarse pitch and wide face teeth. It rotates in two large bronze bearings, of which there is one on either side of the center. The pinion meshing with this gear runs in oil and is mounted on a heavy shaft located in the center of the bed and is driven from the speed change gears located in the left hand end of the bed. Three speed changes are operated from the center of the machine through hardened steel sliding gears running in oil. The carriages are driven from a splined feed rod through steel gears and give a range of four

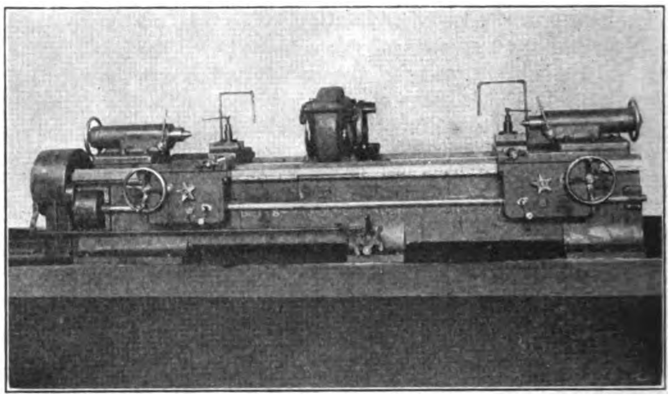


Fig. 2—The Machine with the Filler Blocks in Place for Use as an Axle Lathe

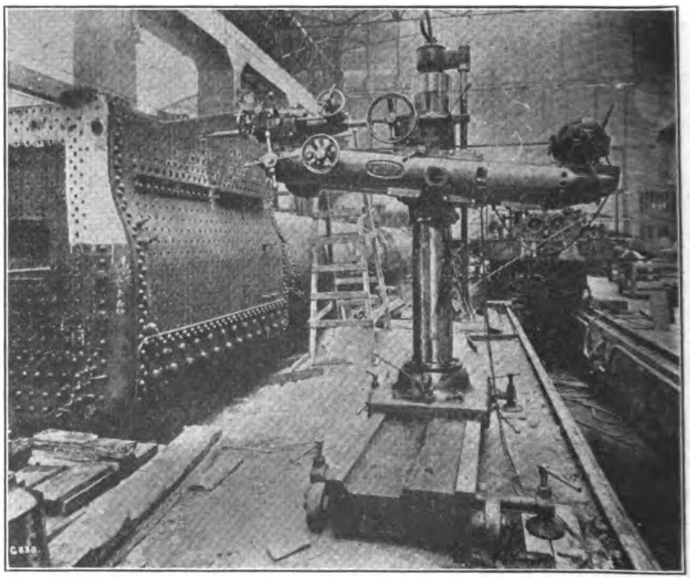
feeds. These feeds can also be changed from the center of the machine.

When the machine is driven by a single pulley or alternating current motor, a powerful friction clutch and automatic brake is used for transmission of power. These are also operated from the center of the machine and give the operator complete control from his normal working position. When driven by a direct current motor, a dynamic brake in the controller is used for quick stopping by means of conveniently mounted push button station. Either a 45-in. or 55-in. swing is furnished in the gaps. Axles of various lengths can be accommodated, as both tail stocks are adjustable along the bed and the carriages have sufficient travel to accommodate the longest journals.

Portable Drilling Machine

A portable universal drilling machine with a broad field of utility has recently been placed on the market by Wm. Asquith, Ltd., Halifax, England, and is available in the United States through C. I. Wroe, New York. The machine has the advantage of ready portability with the addition of greater rigidity than usually found in portable drills. Although the nature of the machine precludes any great rigidity for high speed drilling, it is capable of reasonable cutting rates, and considerable saving is obtained in the combined drilling and handling time on the kinds of work for which it is intended. It is claimed that the low power consumption of this machine gives it an advance over pneumatic drills in the matter of maintenance costs as well as the necessity for extra labor and assistance. It is also said that the breakage in twist drills has been considerably reduced.

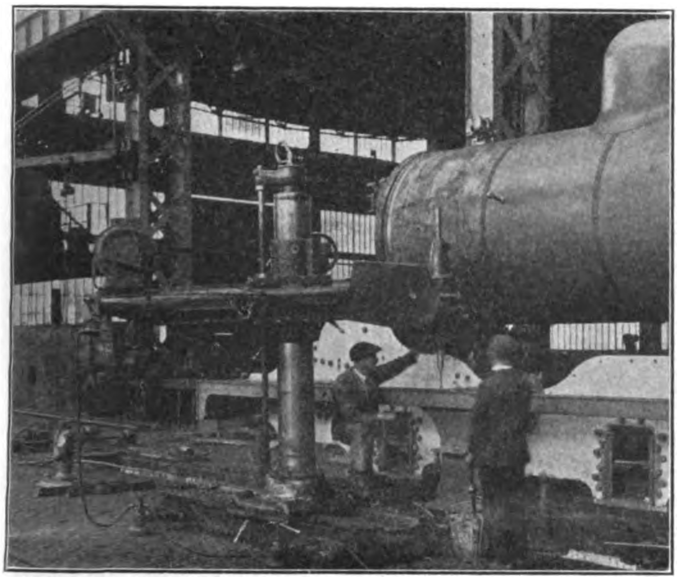
This machine is made in four sizes with a maximum radius of the drilling spindle of 3 ft. 9 in., 4 ft. 9 in., 5 ft. 9 in. and 7 ft. 0 in., respectively. There is also a No. 5 size, but this type does not embody a radial arm. The spindle is of high tensile carbon steel and is provided with variable rates of self-acting feed motion. It is provided with a fine hand feed through a worm and worm wheel and can be adjusted quickly by a conveniently placed hand wheel. The reversing motion to the spindle is controlled by a lever placed in easy reach of the operator. The action of reversing the spindle automatically increases the reverse



Drilling Holes for Staybolts in a Locomotive Firebox

speed in the ratio of about 3 to 1. The drilling head is so arranged that it can be adjusted in either the horizontal or the vertical planes to any angle, and it is equipped with a locking device that holds the head securely in all positions.

All controls are conveniently arranged. The radial arm can be traversed across the column by means of a hand



Asquith Portable Drilling Machine Working in a Locomotive Frame

wheel, and by power in the case of the 7-ft. machine, and can also be elevated on the column either by hand or by power, or moved radially through a complete circle. The arm can also be tilted in a vertical plane through about 30 deg. Secure locking provision is made for all these movements as well as an automatic trip motion for the power elevating and lowering of the arm on the column of the drilling machine.

The base slides easily on the truck bed and is traversed thereon by a ratchet lever. It can be rigidly locked in any position desired. The column is securely bolted to the base and is fitted at the top with a plug that carries the lifting hook. On the 7-ft. machine, the column consists of an internal pillar and sleeve to insure the necessary rigidity, in which case the arm and sleeve rotate on the pillar. This latter motion is facilitated by a patent arrangement of ball and roller bearings.

The truck bed is arranged on four wheels, except in the case of the 7-ft. machine, with screw jack supports to take the weight when drilling and also to give additional support. The drive is by means of a self-contained, reversible electric motor, mounted on the arm end plate. A belt from the motor to a single pulley on the gear box completes the driving mechanism. On the 7-ft. machine, the drive is operated from the motor by means of a driving shaft to the gear box. The gear box provides six speed changes, with the exception of the No. 4 size, which has eight speed changes. These speed changes are obtained by hand wheel control through clutch and sliding gears and are doubled by the double gear on the head.

Guillotine Bar Shears

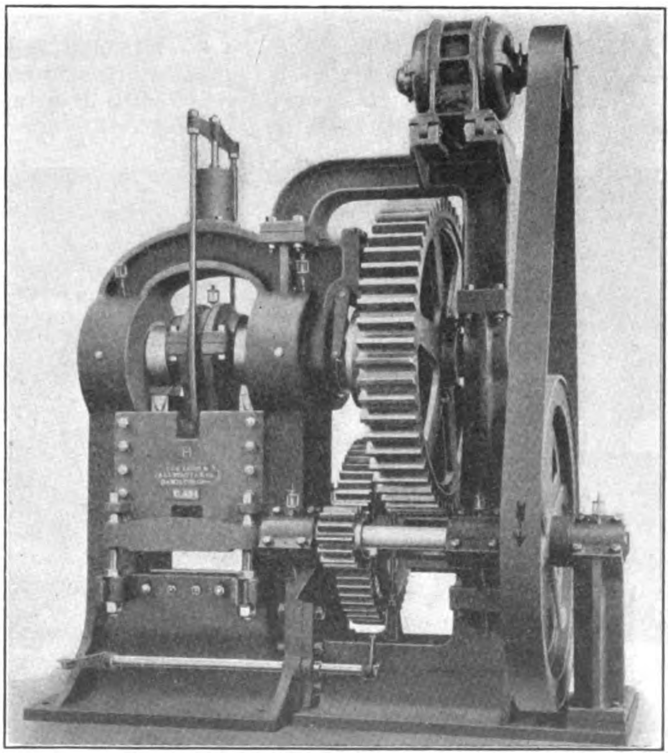
A REDESIGNED line of shears of the guillotine style for shearing off square, round or flat bars, has been brought out by the Long & Allstatter Company, Hamilton, Ohio. The principal aim in the new design was to obtain a rugged and compact machine as free from flexure as possible.

The main frame or housing is made a one-piece casting of the box design, the material used for the large sized machines being annealed steel, and on the smaller machines, a semi-steel mixture is used. The results from tests run for several months show a remarkable endurance of the cutting edges of the blades, which is due to a great extent to the rigid construction that maintains the blades in alinement. The steel slides are long and slide in bronze lined bearings. They are counterbalanced by air or springs, or by weights that operate below the floor level.

The gears are of steel, with machine cut teeth. They are placed to the side to afford a better construction as well as to give unobstructed working room around the back, side and front of the machine. The shaft bearings are extra large and are located so that no gearing is overhung, giving a rigid gear assembly, which compels the tooth load to be distributed across the entire gear face. The bearings also benefit by this design as there is no uneven or cocking action of the shafts.

An improved automatic stop for operating the clutch, which brings the slide to rest with the blades completely open, is provided with a safety locking feature, so that the clutch will engage the driving jaws only when the operating treadle is completely down. The machine can be stopped after each stroke or can be run continually as desired. The fly wheels are sufficiently heavy to relieve the motor, or other driving medium from the high peak load, to which this type of machinery is subjected.

These machines are self contained, the bearings and other parts being supported by one common base, which insures accurate alinement of the entire equipment under all conditions of service.



Guillotine Shears of Rugged and Compact Construction

Vacuum Torch for Railroad Work

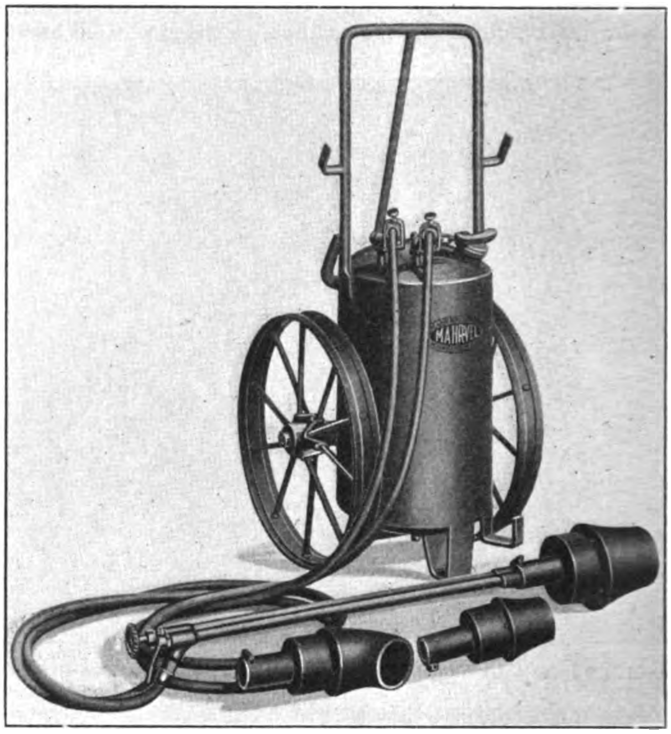
A VACUUM torch of large capacity has recently been placed on the market by the Mahr Manufacturing Company, Minneapolis, Minn. This torch has been specially designed for railway car repair work and boiler shop requirements and its operation is based on the same principle as that of the heating element in the portable rivet forges manufactured by the Mahr company. The important feature of this torch to oil users is the fact that no pressure is used in the oil tank or hose line, making the torch safe to operate.

The tank for the torch is of heavy gage welded construction, with a capacity of 20 gal. and is mounted on a steel axle and large roller bearing wheels. The tank is carefully balanced and can be easily handled over rough ground. Side brackets are used to carry the 12-ft. hose, the torch itself and the extra nozzles. The torch is designed to eliminate trouble in operation. The patented valve-in-head construction gives a positive shut-off and eliminates any tendency to drip at the nozzle. The oil is, therefore, always at the head, which facilitates the instant starting of the torch.

There are separate controls for the oil and air which give a wide range of capacity and adjustment. The air control valve is of the plug cock type and ground to fit. Lack of restrictions in the air passage of the tank reduces the pressure loss to a minimum.

The oil valve is of the piston valve type designed to reduce clogging and is capable of fine adjustment. Both valve controls are placed well back from the torch nozzle for the convenience of the operator. The oil and air tubes are brazed into the body and head, in order to obtain tightness and strength at these joints.

A special atomizing nut causes complete atomization without restricting the air flow and also makes the flame steady and continuous. In the patented double chamber nozzle the vapor is discharged from the atomizer into the first chamber, where it ignites. This burning vapor, in passing through the choke into the second chamber, draws in free air through the auxiliary air openings, thereby making a suitable burning mixture within the nozzle to produce a steady and compact flame.

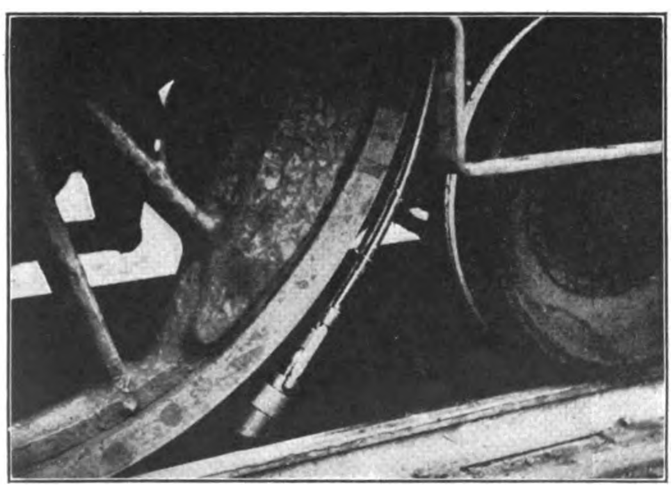


Portable Vacuum Torch of Large Capacity

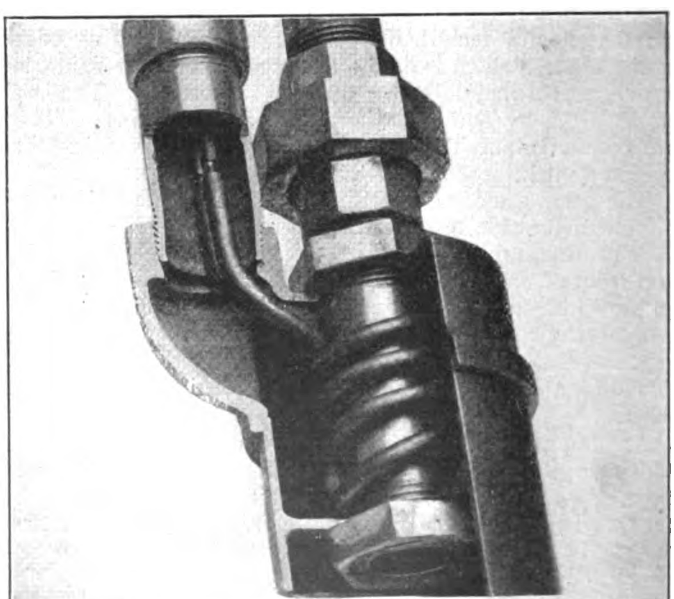
An Electric Sand Pipe Heater

A DEVICE known as the Universal Electric sand pipe heater, designed to keep sand pipes on locomotives, and other types of power equipment, from clogging at the lower end, has been developed by the Universal Electric Sand Pipe Heater Company, 1536 Commercial Trust Building, Philadelphia, Pa.

In stormy weather, the lower end of the sand pipe is always wet and it is a well-known fact that dry sand will not flow from a wet pipe without part of the sand sticking to the



The Heater Applied to a Locomotive



The Heater with a Section Cut Away and Lagging Removed to Show Its Construction

side of the pipe, eventually closing the outlet. The function of the device is to keep the orifice dry, to permit a flow of sand at all times and thereby insure full tractive effort and maximum adhesion for braking when needed.

The heater is a simple device which is screwed on to the lower end of the sand pipe and in effect is a shell which surrounds the pipe. Inside of the shell and touching the sand pipe is an electric heating unit connected to the headlight generator. The space between the heating unit and the outer shell is filled with asbestos lagging. Two sizes of heaters are manufactured, using 64 and 80 watts respectively, and there are two units used on a locomotive.

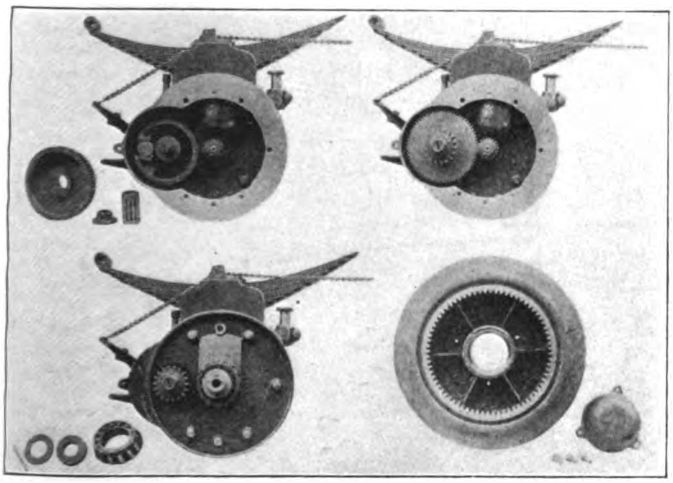
Laboratory tests on the device were made by an Eastern railroad about a year ago. Pipes were set up as on a locomotive with a sand box and valves for sanding the track. Water was allowed to trickle down the pipe and a blast of air equivalent to a cross wind blowing at 30 miles an hour was projected against the end of the sand pipe. Sand was allowed to flow down the pipe every 10 seconds. At the end of an hour and 15 minutes, there was no wet sand in the lower end of the sand pipe.

At a later date a road test was made. A five-gallon can of water was placed on the running board of a locomotive and a hose extending down to a point near the lower end of the sand pipe, was used to trickle water onto the pipe. In making a 50-mile run without the current turned on, the pipe clogged up five times, and had to be cleaned out each time. On the return trip, the current was turned on and the pipe gathered no wet sand.

Another test was made in the freezing room of the Penn Cress Ice Cream Company at Cresson, Pa. The sander was operated at a temperature of zero, with water trickling on the sand pipe. This was continued for two hours, at the end of which period there was nothing in the pipe. On road locomotives, in regular use, the device has been used to keep the sand pipes clear and free from obstruction under a wide variety of conditions of bad weather, including low temperature, rain and snow.

Four Wheel Drive Lift Truck

A LIFT truck that has all four wheels individually driven by a standard vehicle motor has been placed on the market by the Terminal Engineering Company, New York. As shown in the illustration, the truck is equipped with four wheels of the same diameter, instead of



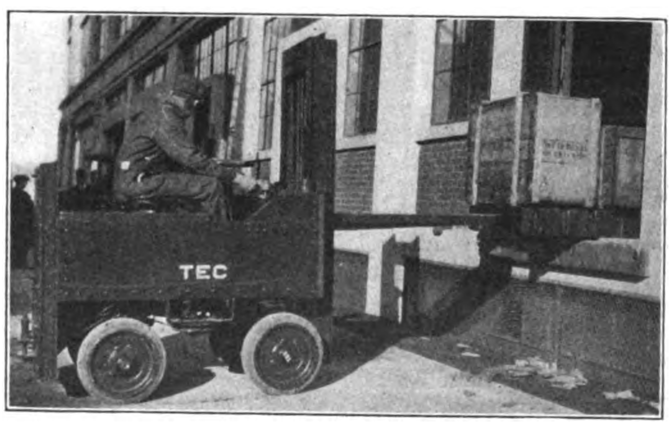
Detail Construction of the Rear Wheel Unit

the small diameter pilot or trailer wheels that are commonly used. It is claimed that the elimination of these small wheels permits greater freedom of action in traversing obstructions, such as crossing cobbled streets and railroad crossings. It is also claimed that the absence of the pilot or trailer structure permits the truck to approach closer to a box car in order to lift material from the floor of the car through the doorway. This truck has also proved to be of value for stacking material in warehouses.

The truck is built with varying heights of uprights to suit different requirements. The table, as shown in the illustration, can drop to a surface height of 5 in. from the floor. It is 4 ft. long by 26 in. wide. Provision has been made for changing the style of the table, which is easily accomplished by dropping out the old table and replacing in the uprights some other type, such as the horn, double tang, or V-type table. The horn type table is intended for handling coiled rod or reels, car wheels, etc. The double tang type, the top of which goes down to within 2 in. of the floor, is designed for handling such material as tin plate and for stacking. Other types of tables are available for any variety of work. The capacity on separable bodies for an evenly distributed load is as follows: 2,100 lb. on a 6-ft. platform; 2,300 lb. on a 5-ft. platform; 2,600 lb. on a 4-ft. platform, and 3,000 lb. on a 3-ft. platform.

The hoist can raise a 3,000-lb. load at a rate of 25 ft. per min. and it can elevate empty at a rate of 50 ft. per min. The hoisting unit is operated by an enclosed watertight motor of the same type as those used in driving the truck. The reduction is through a worm and gear, the worm and shaft being integral. A solenoid is used to release the brake on the motor shaft and an automatic brake is provided to prevent the load from being lowered too rapidly.

It is claimed that this truck can operate effectively in snow and ice conditions, and needs no specially prepared runways. It is carried on four wheels that have 20-in. by 5-in. solid rubber tires 3 in. thick. All four wheels are individ-



Lift Truck Removing Boxes from the Door of a Storehouse

ually driven, each being provided with a standard vehicle motor, fully enclosed and weatherproof. There are three revolving members in the driving unit, consisting of motor shaft, integral reduction gear and pinion and the wheel itself. The entire unit is grease packed and requires practically no attention for long periods. The motor has ball bearings and in addition the reduction gear and the wheel rotate on roller bearings.

Steering is accomplished by the rear wheels. This gives the shortest possible turning radius of 6 ft. 9 in. The rear wheels are equipped with full leaf springs and are provided

with internal expanding type brakes, actuating inside the reduction gear member. The brakes are controlled by the operator's foot. An odometer is provided on one wheel to record mileage.

The battery is placed over the rear wheels in a special compartment. Its location with respect to the load allows it to act as a counterbalance, the front wheels serving as the fulcrum. It also provides a seat for the driver. The counterbalancing effect of the battery is further reinforced by a weight attached at the rear of the truck in the form of a plate. A coupling device is also provided when it is desired to use the truck as a tractor.

New Design of Board Drop Hammer

WITH the object of overcoming difficulties which heretofore have been tolerated as necessary evils in the drop forge shop, Merrill Brothers, Maspeth, N. Y., has developed a board drop hammer in which are embodied several new features. Among the new features in this machine are: Adjustment to compensate for uneven wear of roller bearings; straight friction bar; rigid and non-adjustable upright frames; inserted, adjustable and reversible ram guides; treadle safety block; front and back die adjustments which are immovable when locked by the die key.

In the lifter the arrangement of sliding boxes has been improved by the substitution of roll rockers. The direct horizontal pressure against the board is maintained the same as with sliding boxes, with the advantage of better support for the roll pressure and belt pull. The hammer operates equally as well with the belts driving from the front as from the rear, or one from the front and one from the rear.

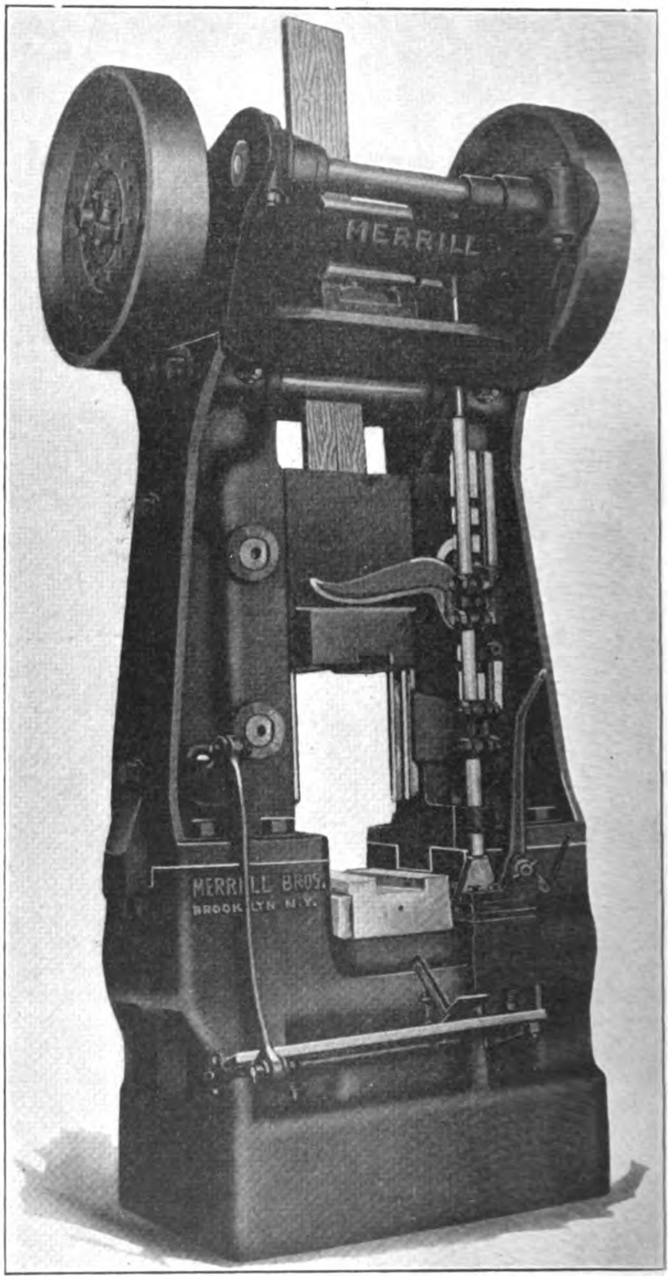
To maintain the rolls parallel, a compensating eccentric has been introduced in one of the eccentric sleeves. This can be adjusted in a few minutes without removing any of the lifter parts. Heretofore this realinement of the rolls could only be accomplished by an adjustment of the set screws or by replacement of the bushings in the roller shaft bearings.

If it is desired, the hammer can be arranged in a few moments to use a thick or a thin lifting board by changing the roll eccentric bushing, the eccentric construction is such that when the friction bar falls, the rolls are practically locked. This arrangement permits the use of a very light friction bar, rolls the board more nearly straight and prevents excessive wear near the point of stick-up.

The main roller bearings are ring oiled from four large oil pockets, that are easily accessible and experience has shown that they do not require oil renewal oftener than once in four weeks. This feature was adopted as the result of seven years' experience on a 2,000-lb. hammer, during which time the roller bearings were never disturbed. Sliding bearings, where the pressure is high, but the movements small, are oiled by means of felt pads soaked in oil from suitable oil reservoirs. All parts subjected to wear are bushed or fitted with wearing plates.

The friction rods are made straight with an eye at the upper end for attachment to the eccentric lever. The roll releasing lever lifts the friction bar to its seat without shock and permits the hammer to run practically at as high speed as the lifting board will stand. It is so constructed that the leverage shortens as the friction bar is raised, by means of a rolling contact on a non-metallic surface on the ram, thereby giving a greater friction roll opening than is possible with a plain lever operating on a ram pin. The under surface of the lever is curved and this places the pressure against the ram constantly in a vertical direction, which practically eliminates the kick-back on the whole roll releasing mechanism. The adjustment for length of stroke can be positively and easily adjusted.

A novel bottom stop for the rod is used wherein both seats for the upper and lower positions of the rod are in one assembly. The entire mechanism is removable by releasing two vertical guide bolts. The wear caused by the drag of the lower end of the rod when it is being raised from its lower position is taken by the front of the stop plate. The base casting is protected from wear and the plate can be easily removed and redressed or renewed at slight cost. Suitable non-metallic plates are placed under the stop seats to take the shock of the falling rod. These plates can be varied in thickness to obtain different positions at which the rod can be brought to rest at its upper and lower positions.



Drop Forge Hammer Built in Sizes Ranging from 600 to 5,000 Pounds Falling Weight

The clamp for holding the ram suspended is adjusted in conjunction with a special treadle. This clamp is placed

under the rolls and is full floating to conform to the alinement of the board. The adjustment is controlled from the floor in the usual way and the complete board clamp assembly can be removed without removing any part of the lifter.

The upright frames are constructed of steel castings of I-beam section. The bearings on the base have been materially increased in every direction; as have also the depth and length of the upright guide in the anvil. The foot of the upright is tightly fitted on four sides to the top of the base. Four hold-down bolts are used instead of the customary two at the center, which, in combination with the lifter construction and tie rods at the top of the uprights prevents the possibility of the uprights rocking on the base.

Dirt clearance under the upright foot in the anvil has been provided so that all dirt and scale can be removed without taking down the upright from the base, in fact the clearance surfaces are so pitched that the dirt will take care of itself through an outlet at the side of the base.

The upright feet are deeply guided in the anvil for their full length from right to left and the side thrust from breakdown work is taken up in such a manner as to make failure at this point on either upright or base practically impossible.

Truing up the V's of the uprights has been taken care of by the adjustable and reversible ram guides, which are fitted to the steel upright frames. It is claimed that on account of the ease of removing and re-planing the inserted guides, the V's cannot become badly worn. Besides being reversible, the guides have double V's thereby prolonging the life of the wearing surfaces. The inserted guide adjustment is simple and positive, and so constructed that the guides can be dropped back into the uprights to allow the ram to be removed, as well as to take up for uneven wear at the bottom of the guide and ram. By adjusting both the bottom and top guide adjusting wedges, the face of the ram can be squared up from right and left with the face of the shoe. Inequality often occurs here owing to the uneven wear of the guide and ram. The adjustment of the inserted ram guides is made from the floor.

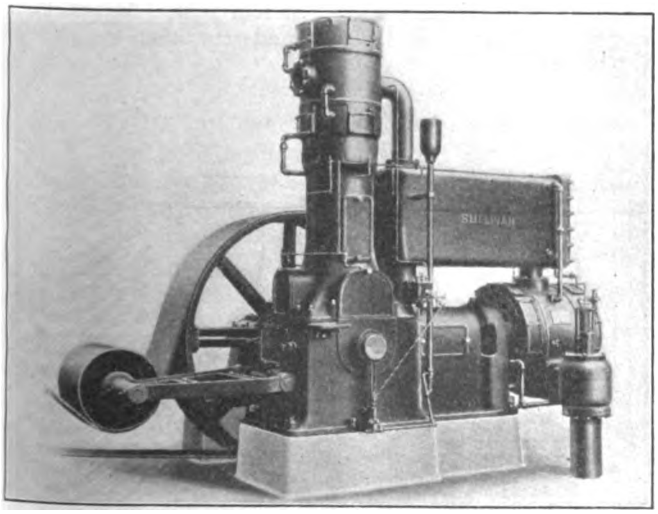
Many serious accidents occur through the accidental tripping of the treadle. A simple and positive device has been applied which makes it is impossible to trip the treadle except by placing the foot on a pad about 6 in. square. This pad can be quickly adjusted from right to left to suit the convenience of any operator. As long as the tripping pad is not touched, a person can stand with his full weight on the treadle without tripping the ram. If the safety device is not desired, it can easily be removed and the treadle operated in the usual manner.

Die adjustment from front to back is accomplished by means of a double taper insert in the top of the forged steel shoe opposite the die key. This construction is positive and the die cannot get loose without the die keys coming out. This hammer is built in sizes ranging from 600 lb. to 5,000 lb. falling weight.

Sullivan Belt Driven Air Compressor

RECENT changes in the design of the angle compound compressor, built by the Sullivan Machinery Company, Chicago, Ill., has brought about an improvement in its general efficiency and economy.

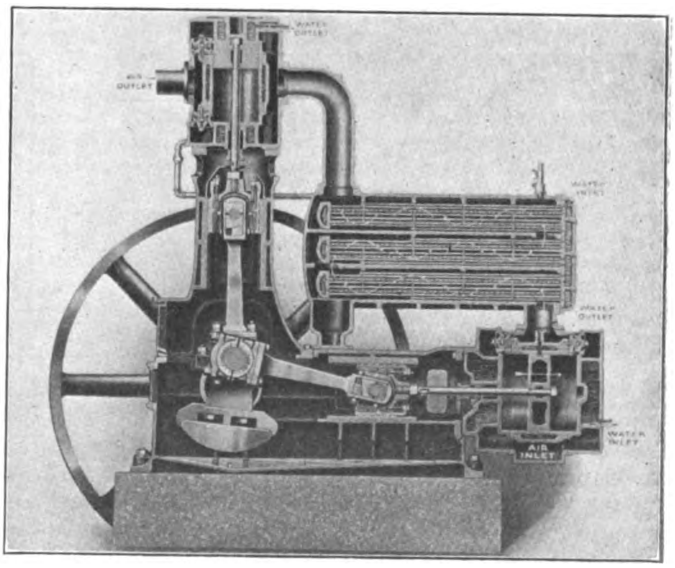
These compressors are now equipped with standard wafer valves, which consist of thin, flat rings of tempered steel, held to their seats by leaf springs of the same material. The wide port opening, low lift and simplicity of these valves are designed to produce high volumetric efficiency and long life. The valves for both inlet and discharge are set in tandem in the same port or pocket, as shown by the illustration, thus reducing the clearance factor to a very small amount.



View of Compressor from Air Inlet Side

Another important improvement recently adopted is the three pass, counter-current intercooler, shown by the sectional view. In this intercooler, three separate nests of water tubes are arranged, one above the other, in a large shell. The air from the intake cylinder is conducted by means of baffle plates five times across each set of tubes, so that it comes in contact with the cooling water no less than fifteen times in its progress to the discharge cylinder. This added cooling surface results in a considerable increase in the air end efficiency of these compressors.

The machine is constructed with one high pressure and one low pressure cylinder. The low pressure cylinder is located horizontally and the high pressure cylinder vertically. The main, or horizontal frame, to which the low pressure cylinder is directly attached, consists of a single, massive casting, supporting the entire machine. A heavy pedestal, supporting the high pressure cylinder, rests on the main frame. A single crank pin drives both low and high pressure pistons and all moving parts are entirely enclosed within the frames.



Sectional Elevation Showing the Three-Pass Intercooler

Powerful Turret Lathe and Tooling Arrangement

The addition of a powerful, 9¼-in. spindle bore turret lathe to its standard line of lathes is announced by the Gisholt Machine Company, Madison, Wis. This machine is designed to handle locomotive crank pins and other bar work too large for the 7½-in. and 8¼-in. spindle bore machines made by this company. The headstock of the new lathe has been simplified and designed for a 20-hp. motor which will give ample power for the heavy roughing cuts needed on the heavier work. Another feature designed to increase production is the quick traverse of the tool post carriage. Fig. 1 clearly shows the rugged proportions of the new turret lathe and its adaptability for heavy chucking and bar work.

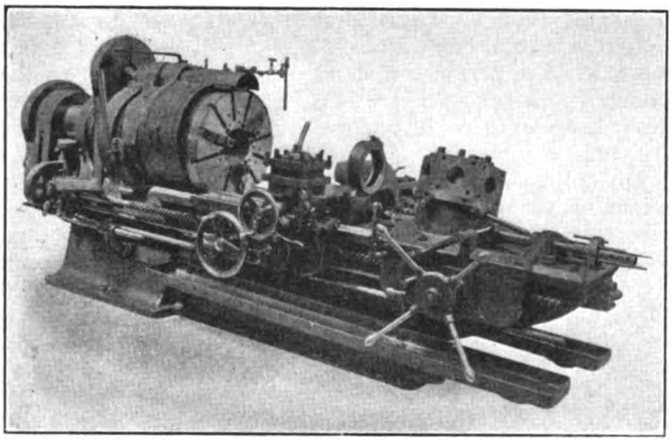


Fig. 1—Gisholt Turret Lathe for Heavy Work

The Gisholt Machine Company has made a careful study of the tools required to produce railroad bar and chucking work, such as crank pins, wrist pins, piston valve packing rings, etc. By means of a special tooling arrangement the crank pin illustrated in Fig. 2 is said to be machined in 50 min. Referring to Fig. 3, the various operations in finish machining a crosshead wrist pin are clearly indicated.

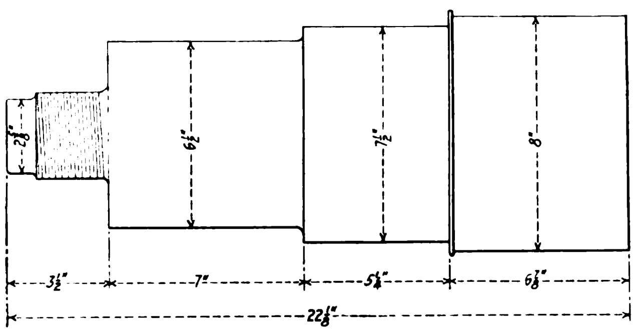


Fig. 2—Main Locomotive Crank Pin Machined in 50 Minutes

At position 1, the end of the pin is roughed down and the pin cut off part way. The pin is rough turned on all surfaces at position 2, and finish turned with the same tooling arrangement at position 3. At position 4, the end of the pin is threaded with a self-opening die in the turret and where necessary the pin end centered with a rack and pinion centering tool. Where the pin is to be lubricated by a grease cup or other means of forcing lubricant through the end of the pin into the bearing a center hole is drilled as shown at position 5. The tapering operation is performed at position 6 and the final tapping and cutting off operations at position 7. The time per pin with this tooling arrangement is approximately 20 min., where the overall dimensions are 4½ in. by 11 in. If wrist pins are being made at some central point and simply rough machined, the number of operations is reduced by two and the tooling equipment can be reduced accordingly, the time in this case, on a 5-in. by 12-in. pin being 15 min.

The tooling arrangement used in machining piston valve packing rings is illustrated in Fig. 4. In this case the packing pot is held in the chuck, the cutter head traveling on a turret bar piloted in the chuck. The cutter head carries four tools and in position 1 bores the packing pot. In this same position the outside of the pot is rough- and finish-turned by a tool in the wing rest tool post. At position 2 the packing ring is first rough undercut, then finished on the back face, then finished on the front face and finally cut off. A tooling arrangement has also been developed for machining valve spiders and bullrings. The following is the production record said to have been obtained with these tooling arrangements:

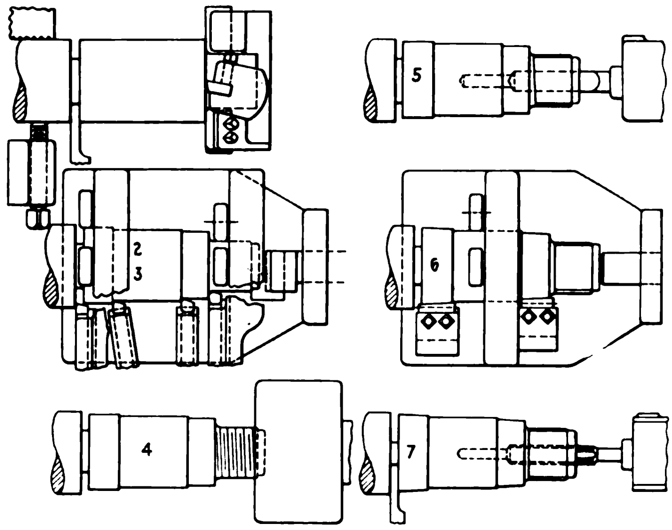


Fig. 3—Tooling Arrangement for Finishing Crosshead Wrist Pins

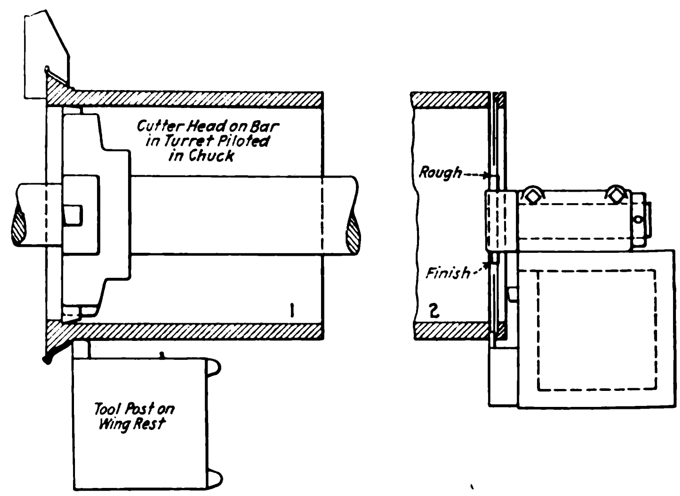


Fig. 4—Tooling Set-Up for Piston Valve Packing Rings

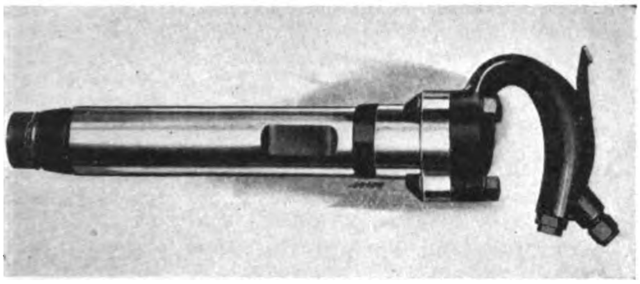
14-in. packing rings	8 min.
24-in. packing rings	12 min.
12-in. valve spiders	10 min.
24-in. valve spiders	15 min.
14-in. bull rings	12 min.
24-in. bull rings	20 min.

A particularly desirable feature of the Gisholt tooling plan is the provision for furnishing a partial set of tools in case a given machine is confined entirely to roughing operations. This obviates the necessity of buying a full set of tools, some of which may not be needed for machines on specialized work.

A New Type of Riveting Hammer

THE Ingersoll-Rand Company, New York, has developed a new type of pneumatic riveting hammer with improved features, including bolted construction for holding the handle to the barrel, heavy section valve with liberal bearing surfaces; combination poppet and piston type throttle valve, low air consumption, and easy operation.

These hammers are manufactured in three styles, A, B and C and are available in a complete range of sizes from a 5-in. to a 9-in. stroke. Each size can be procured with any one of three types of barrels and with either outside or inside trigger handles. The standard A type has a barrel machined to accommodate a rivet set clip only.



Pneumatic Riveter with Bolted Barrel and Handle Connection

Three alloy steel bolts of substantial size, fitted with lock washers, hold the handle to the barrel. This enables the hammer to be taken apart anywhere for inspection or cleaning with the aid of a wrench.

The throttle valve, except on inside trigger handles, is a combination of the piston and poppet types, having the nicety of control of the piston valve and the freedom from leakage of the poppet type. It is claimed that the beveled seat will remain tight throughout the life of the tool. The throttle lever or trigger is made in one piece from special heat treated spring steel and has a long bearing in the handle.

The valve is a sturdy sleeve made from special alloy steel. It has liberal bearing surfaces and its walls are free from holes or ports. It operates in a valve box of strong construction, located in the head of the barrel. The valve box is constructed with a solid end which enables it to be easily taken apart by the use of a piston for the removal of the valve, without recourse to the use of a screwdriver or similar tool. This construction also insures a compression chamber in the valve box which cushions the piston on the return stroke and prevents its striking the handle. The handles are of high quality steel, drop forged to a shape that fits the hand and are sand blast finished to give a positive grip. Either outside or inside trigger handles can be furnished, although the outside type is standard. The exhaust is through the side of the barrel near the handle and can be deflected in any direction desired by merely turning the deflector.

Portable Electric Hammer

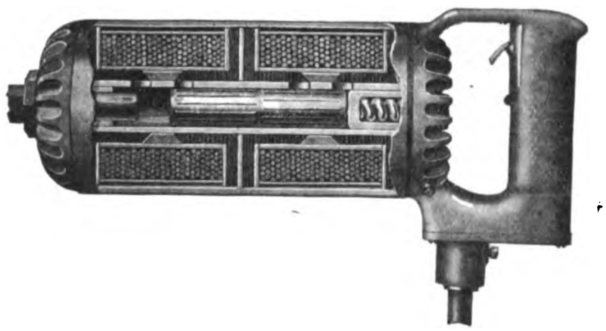
A PORTABLE tool known as the Syntron electric hammer is being manufactured by the National Electric Manufacturing Company, Pittsburgh, Pa. It is designed to run on 60-cycle current and at this frequency strikes 3,600 blows per minute. It is suitable for drilling through masonry walls, drilling holes for expansion bolts, chipping castings, light riveting and assembly work, chipping and cracking stone, calking pipe and tank plates. A similar tool designed for 25 cycles which will strike 1,500 blows per minute can be used for heavier riveting.

The hammer proper consists of two windings which are energized alternately to impart a reciprocating movement to a movable core or piston, which is the only moving part. In its forward stroke, the piston strikes a tool, which may be a drill, chisel, rivet set or the like. In its backward stroke the piston strikes an elastic bumper in which it stores its kinetic energy until it is moved forward again. The energy stored in the bumper is then returned to the piston on the forward stroke.

To operate the hammer, alternating current is supplied to the two windings to energize them alternately so as to impart a reciprocating movement to the piston, which will move in synchronism with the frequency of the alternating current supplied to the windings. The current alone produces the operating forces to move the piston. No mechanical devices are used.

The hammer is rugged in construction and aside from an occasional oiling of the piston, needs no attention. The piston is made of special hardened steel and will last indefinitely. A trigger switch on the handle of the hammer starts and stops the hammer.

The hammer meets the need of a portable hammer drill that can be carried from job to job. It can be connected to any lamp socket. The hammer is at present available in three sizes, one weighing 10 pounds, the second weighing



The Syntron Electric Hammer Showing the Coils and Piston Slide in Section

17 pounds and the third weighing 24 pounds. All sizes are available for 110 or 220 volts and any frequency. The power consumption of the 17-lb. hammer is 300 watts. Two carrying kits are supplied to hold the hammer and a control box, together with a 50-ft. extension cord and a complete assortment of drills, chisels and stone points.

GENERAL NEWS

Pulverized coal is being adopted on some of the locomotives of the Japanese railways. Experiments on the use of pulverized coal for locomotive firing also are being made by the Railway Commissioners of Australia.

The Southern Pacific has just put in effect what is claimed to be the longest regular locomotive run in the world, 815 miles, between El Paso, Texas, and Los Angeles, Cal. These engines are of the 4-8-2 type and haul through passenger trains.

The strike of shopmen on the Chicago, Burlington & Quincy, which began on July 1, 1922, has been officially terminated by the Railway Employees' Department, American Federation of Labor. No settlement with the employees was made by the management of the Burlington.

Beyer, Peacock & Co., Ltd., Gorton, Manchester, England, has, according to Modern Transport (London), completed arrangements with the Aktiebolaget Ljungström Angturbin of Stockholm, Sweden, for the manufacture in England of the Ljungström turbine locomotive for service in Great Britain and the British colonies. Beyer, Peacock will build one of these locomotives for purposes of demonstration on the British railways. The Ljungström company will shortly place one of these locomotives in service on the Argentine State Railways.

Locomotive Deliveries in December

The Department of Commerce has prepared the following table, based on reports received from locomotive builders, showing shipments of locomotives in December, 1923, as compared with the same month in 1922, and also the year's totals similarly compared:

	December, 1923	November, 1923	December, 1922	Year's total January to December 1923	1922
Shipments—					
Domestic	305	270	194	2,985	1,056
Foreign	24	29	16	204	218
Total	329	299	210	3,189	1,274
Unfilled orders (end of month)—					
Domestic	365	656	1,490	...	...
Foreign	22	35	94	...	...
Total	387	691	1,592	...	...

Labor Board Sustains S. P. & S. in Reduction of Wages

The Labor Board has approved the action of the Spokane, Portland & Seattle in reducing the wages of its supervisory forces in the mechanical department in accordance with Decision No. 147 of the Labor Board, in which the road was not included. The Labor Board, in its decision, took into consideration the fact that the Spokane, Portland & Seattle is owned by the Great Northern and the Northern Pacific and that it has fixed the wage rates for its employees in accordance with those on the roads owning it. The International Association of Railroad Supervisors of Mechanics, which claims to represent the supervisory forces, declared that the reduction had been ordered without conferences with representatives of the employees. The management, however, claimed that there were no authorized representatives of the supervisors at that time and the Labor Board upheld this contention.

Labor Board Decisions

Installation of Stokers Denied.—The Labor Board has remanded to the Brotherhood of Locomotive Engineers, the Brotherhood of Locomotive Firemen and Enginemen and the Chicago, Indianapolis & Louisville, a dispute over the necessity of employing two firemen on certain engines operated by the road. The board denied the request that it order the installation of mechanical stokers on such engines. The employees requested that locomotives weighing from 170,000 lb. to 279,000 lb. on the drivers be equipped with mechanical stokers or that two firemen be assigned to such engines.—*Decision No. 2069.*

Compensation for Meal Period.—In a dispute between the Railway Employees' Department of the American Federation of Labor and the Norfolk & Western over the question of the granting of pay for the meal period to employees on all shifts where three shifts are worked, the Labor Board ruled for the employees. "Where three shifts are employed, the spread of each shift shall consist of eight consecutive hours including an allowance of 20 minutes for lunch within the limit of the fifth hour. This decision is applicable only if the provisions of Rule 2, Addendum 6 to Decision No. 222 are considered in full force and effect on this road and where a different application of this rule has not been agreed to between the road and the employees."—*Decision No. 2059.*

Locomotive and Freight Car Repair Situation

Locomotives

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. repairs over 24 hr.	Per cent req. repairs over 24 hr.
1923					
January 1	64,453	48,905	576	13,587	21.1
April 1	64,559	50,107	914	12,801	19.8
July 1	63,906	52,456	2,181	10,326	16.2
Oct. 1	63,982	54,159	2,620	8,787	13.7
November 1	64,192	54,080	2,517	9,163	14.3
December 1	64,336	53,764	3,367	9,577	14.9
1924					
January 1	64,406	54,031	5,061	9,395	14.6

Freight Cars

Date	No. freight cars on line	Cars awaiting heavy repairs	Cars awaiting light repairs	Total cars awaiting repairs	Per cent of cars awaiting repairs
1923					
January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	2,270,405	116,697	38,929	155,626	6.8
1924					
January 1	2,279,363	118,653	39,522	158,175	6.9

Trackmen and Shopmen Get Higher Pay

Wage increases of one and two cents an hour have been granted by the Labor Board to maintenance-of-way employees and shop laborers on the Boston & Maine, the Fort Smith & Western, the Louisville & Nashville, the Louisville, Henderson & St. Louis, the Nashville, Chattanooga & St. Louis, the San Antonio, Uvalde & Gulf and the Trinity & Brazos Valley. These increases were ordered by the Board after the roads involved were unable to arrive at amicable agreements with their employees subsequent to Labor Board Decision No. 1861 under date of June 30, 1923, in which the Board remanded the maintenance-of-way employees' wage increase requests back to the roads for further efforts at adjustment. The increases ordered by the Board were not blanket increases but varied considerably on the different roads. On the Boston & Maine, the only increase was granted to crossing watchmen, who will receive an additional two cents an hour. On the Fort Smith & Western the only increase was one of one cent an hour to track laborers. On the Trinity & Brazos Valley bridge and building foremen and their assistants received an advance of two cents an hour, but the other classes on the road received no increase. On the Louisville & Nashville, the Louisville, Henderson & St. Louis and the Nashville, Chattanooga & St. Louis, with the exception of the shop laborers on the last named road, the employees received the following increases: Bridge and building foremen and assistants, section foremen and assistants, and mechanics of the maintenance-of-way department, two cents an hour; mechanics' helpers,

track laborers, drawbridge tenders and assistants and shop laborers, one cent an hour. Employees on the San Antonio, Uvalde & Gulf received increases as follows: Bridge and building foremen and assistants and section foremen and assistants, one cent an hour; mechanics, two cents an hour; and the remaining classes, one cent an hour.

Inspection Bureau Finds Defective 43 Per Cent of Locomotives Inspected

The Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment shows that during November 5,653 locomotives were inspected by the Bureau of Locomotive Inspection, of which 43 per cent were found defective, and 466 were ordered out of service. Also, 101,539 freight cars were inspected by the Bureau of Safety, of which 4.9 per cent were found defective and 1,855 passenger cars, of which 1.5 per cent were found defective.

The monthly report for December shows that of 3,321 locomotives inspected, 2,115 were found defective and 405 were ordered out of service. Of 54,090 freight cars inspected by the Bureau of Safety, 1,830 were found defective. During December, 1922, of 62,780 freight cars inspected 5,146 were found defective. During December, 1923, no information of violation of the safety appliance laws was transmitted by the commission to any of the United States attorneys.

At Indianapolis, Ind., on January 14, inspectors of the Interstate Commerce Commission ordered out of service a large number of locomotives of the Pennsylvania Railroad, said to be unfit for service; and, according to press dispatches, several important passenger trains left Indianapolis one or two hours, or more, behind time because of delay in securing locomotives for them.

Changes in Purchases and Stores Organization on the Pennsylvania

A reorganization and consolidation of the purchasing department of the Pennsylvania is in process of being effected. The practice heretofore in effect of buying supplies for each of the four regions separately will be discontinued. In its place a plan will be adopted by which all materials and supplies will be classified into groups, or sections, with a designated officer of the purchasing department in charge of the buying of each group. The work of all groups will be carried on directly under the supervision of Samuel Porcher, general purchasing agent of the system, whose headquarters will continue to be in Philadelphia. Assistant purchasing agents will also be stationed at Pittsburgh, Chicago and St. Louis, reporting to the general purchasing agent. Their duties will be to co-operate with the vice-presidents and other authorities of the Central, Northwestern and Southwestern Regions, respectively. As the headquarters of the Eastern Region are in Philadelphia, it is not considered necessary to make a similar arrangement for the Eastern Region. Simultaneously with the changes in the purchasing department, a somewhat similar organization will be made of the stores department. C. D. Young, general supervisor of stores will continue to be the head of the department, with the new title of stores manager, and will have his offices in Philadelphia, as heretofore. Under his jurisdiction the handling of stores will be directed from Philadelphia and Altoona, Pa. At each of these points a General Storekeeper will be appointed, with the required assistants.

MEETINGS AND CONVENTIONS

Purchases and Stores Convention at Atlantic City

The general committee of Division VI, Purchases and Stores, of the American Railway Association, will hold its 1924 annual meeting in Atlantic City, N. J., on June 16-18. This meeting will coincide with the last half of the meeting of the Mechanical Division. The latter meeting will be held on June 11-18.

American Society for Steel Treating

The sixth convention and international steel exposition of the American Society for Steel Treating will be held in Boston the week of September 22 to 26, inclusive. Through the courtesy of Governor Channing H. Cox and Chairman William F. Williams of the division of highways and waterways, permission has been granted the society to use the Commonwealth Pier for the exposition. This pier is ideally located and has wonderful facilities for the exhibition. All of the spaces will be on one floor, as can be judged from the dimensions of the Pier, which are 120 ft. by 1,200 ft. The program committee, under the direction of L. D. Hawkridge, held a meeting in New York in December and laid plans for the convention papers and it is confidently expected that the papers will be of such caliber that the meeting will be more than comparable with the wonderful technical sessions held in Pittsburgh last year.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 2-5.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting February 12. Paper on Ventilation and Heating of Railway Passenger Cars will be presented by K. F. Nystrom, engineer design, C. M. & St. P., Chicago. Stereopticon views.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next interim meeting February 7. Report on Interchange Rules with recommended changes will be discussed at regular meeting in March by W. H. Sitterly, chairman.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting February 12. General entertainment and dinner.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. P. Hutchison, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting February 12. Paper on The Locomotive of Today will be presented by James Partington, American Locomotive Company.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting February 8. Paper on Steel, illustrated by moving pictures, will be presented by G. A. Richardson, Bethlehem Steel Company.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

Alexander McIver has been appointed supervisor of heavy traction development of the Westinghouse Electric & Manufacturing Company.

W. J. Behlke, for some years past mechanical representative of Barco Manufacturing Company, Chicago, has been appointed district sales manager.

The Armstrong Cork & Insulation Company, Pittsburgh, Pa., has removed its Minneapolis, Minn., office to larger headquarters at 316 Third avenue, North, Minneapolis.

W. M. Rogovine, for the past thirteen years in the New York sales department of the American Steel Foundries, Chicago, died on January 11 at his home in New York City.

The Lehon Company, Chicago, manufacturers of Mule-Hide roofing, has removed its New York City office from 1 Liberty street to 95 Liberty street. This office is in charge of F. T. Carpenter.

Edwin A. Hall, assistant secretary and treasurer and assistant to the president of the Standard Stoker Company, Inc., died at Scarsdale, N. Y., on January 20. Mr. Hall's headquarters were at the New York office, Grand Central Terminal.

W. G. Cook, manager of the Chicago and Philadelphia offices of the Garlock Packing Company, has become associated with the Union Asbestos & Rubber Company and will represent this company in the East, with headquarters at Philadelphia, Pa.

Glenn A. Wilson has been appointed manager of the Gibb Instrument Company, Bay City, Mich., for New York and New England territory, with headquarters at 120 Liberty street, New York City. Mr. Wilson formerly represented the Mutual Electric & Machine Co.

Fred M. Ball has been appointed district manager of the Franklin Railway Supply Company, Inc., with headquarters at Philadelphia, Pa. Since 1920 Mr. Ball has served as resident inspector at the Baldwin Locomotive Works for the Franklin Railway Supply Company, Inc.

R. E. Ludwick, formerly sales manager for the Cleveland Crane & Engineering Company, Wickliffe, Ohio, has joined the sales staff of Whiting Corporation, Harvey, Ill. Mr. Ludwick will make his headquarters at the Chicago sales office, 945 Monadnock block, Chicago, Ill.

The Chicago Pneumatic Tool Company is preparing plans for a three-story brick and steel factory, to cost approximately $50,000, at Cleveland, Ohio. The General Machinery Company, Spokane, Wash., has been appointed its agent in the eastern part of Washington and northern Idaho.

Arthur Melville White, for many years superintendent of the American Locomotive Company at Schenectady, N. Y., who had also served at Manchester, N. H., and at the Cooke Works, Paterson, N. J., died on January 13 at Manchester. Mr. White was born in 1846 at Ghent, Ohio.

The Chicago Bearing Metal Company and the Bostwick Lyon Bronze Company have been merged and the operation of both plants is under the supervision of William S. Bostwick and Chester A. Lyon. These companies make journal boxes and locomotive brasses and have plants at Chicago, Ill., Waynesboro, Pa., Hagerstown, Md.

The Hauck Manufacturing Company, Brooklyn, N. Y., manufacturers of oil-burning appliances, has appointed A. M. Thomson Philadelphia district representative, with office at the Bourse, succeeding R. B. Ecker, resigned. Mr. Thomson formerly represented the Hauck Manufacturing Company in northeastern Pennsylvania, Canada and New England.

C. H. Davies, for many years in the service of S. F. Bowser & Co., Inc., Fort Wayne, Ind., as manager of its factory division in Chicago, has assumed charge of the factory sales promotion division of the entire Bowser organization, with headquarters in Fort Wayne. Mr. Davies relieves L. E. Porter, assistant general manager, of this branch of the promotion service and now works in collaboration with T. D. Kingsley, general sales manager.

Joseph Teipel, assistant general manager; W. F. Exner, secretary, and F. G. Langbein, purchasing agent of the Mancha Storage Battery Locomotive Company, have resigned to organize the St. Louis Steel Casting Company, St. Louis, Mo., for the manufacture of steel castings. Officers of the new company are: Joseph Teipel, president; Walter F. Heinicke, vice-president; W. F. Exner, secretary, and F. G. Langbein, treasurer.

The Pawling & Harnischfeger Company, Milwaukee, Wis., manufacturers of excavators, cranes and machine tools, has opened new offices in the south. N. B. Norris, formerly district manager at New Orleans, is now district manager at Memphis, Tenn.; D. J. Murphy, formerly at New Orleans, is district manager of the Texas district, with headquarters at Dallas, Tex. F. W. Truex will continue as district manager at Atlanta, Ga., and W. J. Dugan, as southern sales manager, will assume charge of the entire southern territory, with headquarters at Memphis, Tenn.

L. P. Duggan, who for many years represented the Garlock Packing Company, Palmyra, N. Y., covering the railroads in the Middle and South Atlantic states, and of late packing representative for the United States Rubber Company, has recently resumed his affiliations with the Garlock organization. His headquarters are at the Garlock sales branch, 1211-17 Arch street, Philadelphia, Pa. R. J. Hinkle, former railroad representative of the Garlock Packing Company out of its Philadelphia sales branch, will now cover the railroads in the mid-west territory with headquarters at the Chicago branch, 326 West Madison street.

Joseph F. Farrell, who has been general manager of the Nathan Manufacturing Company, New York City, for the past seven years, has been elected vice-president with headquarters in New York City. Mr. Farrell entered railroad service on December 12, 1889, as a clerk on the Lake Shore & Michigan Southern. In September, 1906, he was appointed chief clerk in the purchasing department of the Lake Erie & Western. The following April he was appointed assistant purchasing agent of the Michigan Central and on September 1, 1907, he became purchasing agent of that road. Mr. Farrell left the railroad field in July, 1912, to become vice-president of the American Materials Company and since August, 1916, has served as general manager of the Nathan Manufacturing Company, until his election as vice-president of the same company as above noted.

J. F. Farrell

At a recent special meeting of the board of directors of the Q & C Company, New York, the following officers were elected: Chairman, Charles F. Quincy; president, Frank F. Kister; secretary and assistant treasurer, Marinus Iseldyke, Jr.; auditor, Ralph R. Martin; assistant secretary and cashier, Chester A. Gaskill, and mechanical and consulting engineer, E. Ray Packer. The following vice-presidents, in charge of district sales, have also been elected: Edgar M. Smith, Baltimore; Richard J. McComb, Chicago; James L. Terry, St. Louis, and Lester T. Burwell, New York. Mr. Packer also is vice-president in charge of manufacturing.

Crawford McGinnis has been appointed vice-president of the Pyle-National Company, Chicago; L. H. Vilas has been appointed assistant general manager, and George E. Haas has been appointed special representative. Crawford McGinnis was born in Oakland City, Ind., in 1880. He received a common school education in the western states and served his apprenticeship as a machinist on the St. Louis-San Francisco. He followed railroad work, with the exception of a short time at sea, specializing in the air brake. His earlier experiences were in Mexico and Central America. Mr. McGinnis left the service of the Minneapolis, St. Paul & Sault Ste. Marie in 1912, to represent the Pyle-National Company. Lawrence H. Vilas was born in New York City in 1895. He received his education at St. Paul's School, Concord, N. H., and shortly after

leaving school he enlisted in the New York National Guard and served overseas in France in the World War. After the close of the war he took up work with the Pyle-National Company. George E. Haas was born at Wadsworth, Nev., in 1883, and was educated in the schools of California and Minnesota. After serving a two-year apprenticeship with the Milwaukee Electric Company, he completed a full machinist apprenticeship in the shops of the Chicago, Milwaukee & St. Paul, at Milwaukee. He is familiar with railroad development, having specialized in air brakes and electric equipment.

Horace W. White, Jr., who entered the service of the T. H. Symington Company in February, 1916, has been appointed manager southern sales, with headquarters at Baltimore, Md., to fill the position formerly held by T. C. de Rosset, deceased. Mr. White will continue to report to R. H. Gwaltney, vice-president in charge of eastern sales at New York. Horace W. White was born in Baltimore on May 7, 1888, and graduated from Franklin High School, Reisterstown, Md. He entered the employ of the Keystone Coal & Coke Company in 1904, and was later employed by the Mercantile Trust & Deposit Company, Baltimore. In February, 1916, he entered the employ of the T. H. Symington Company at Rochester, N. Y., and was granted leave of absence during the World War. He first served in the artillery and was transferred to the air service in which he attained the rank of captain in command of the 182nd Aero Squad, where he saw service in France.

H. W. White, Jr.

F. O. Brazier, manager eastern railway sales of the Murphy Varnish Company, has been made general manager of railway sales for that company, with headquarters in Newark, N. J. Mr. Brazier was born in Boston, Mass. After graduating from the high school at Fitchburg, Mass., he entered the service of the mechanical department of the Fitchburg Railroad, where he remained for about six years. Following this he was for three years in the mechanical department of the Illinois Central, after which he entered the sales department of the Lappin Brake Shoe Company, which was later absorbed by the American Brake Shoe & Foundry Company. He became associated with the railway sales department of the Murphy Varnish Company almost 22 years ago, since which time he has been continuously with that company. For the first six years of this period he made his headquarters at Chicago, later coming to New York. He was made manager of eastern railway sales about three years ago. Mr. Brazier is a son of F. W. Brazier, who for so many years was at the head of the car department of the New York Central.

F. O. Brazier

W. G. Andrews of the sales department of Pratt & Lambert, Inc., Buffalo, N. Y., has been appointed sales manager of the central division and has taken over the work formerly handled by J. H. Waterbury, deceased; Mr. Andrews is also a director of the company; J. C. Roth, sales representative, has been appointed assistant sales manager of the central division; W. R. Fuller, manager of industrial sales, has been appointed technical director, in charge of all technical work; T. E. Murphy, formerly in charge of the railway department, central division, has been promoted to assistant manager of industrial sales; J. G. Schroeder, assistant resident manager at Chicago, has been appointed sales manager of the western division and H. S. Campbell, who was sales representative, is now manager of industrial sales of the western division.

Victor R. Willoughby, acting general mechanical engineer of the American Car & Foundry Co., has been appointed general mechanical engineer, in charge of the engineering section and J. A. V. Scheckenbach has been appointed general improvement engineer, in charge of the improvement and research section; both with headquarters at New York City. Victor R. Willoughby was born in Michigan and graduated from the University of Michigan in 1896, with the degree of B.S. and M.E. He began work with the Michigan-Peninsular Car Company in 1897 at the old Michigan plant. He served in 1899 at St. Louis as chief draftsman of the American Car & Foundry Co., and in 1901 at St. Charles in the passenger car department. In 1905, he served at Jeffersonville as mechanical engineer, and in 1917 at Detroit in the World War organization as assistant manager of artillery and later in the shell departments. In 1920 he was transferred to New York as assistant general mechanical engineer; since 1922 he served as acting general mechanical engineer until his recent appointment as general mechanical engineer as above noted.

Robert D. Sinclair, executive vice-president of Mudge & Company, Chicago, has been elected president to succeed Burton Mudge, who has been elected chairman of the board of Mudge & Company in addition to his duties as executive vice-president of the Bradford Corporation. Albert C. Force, treasurer and assistant general manager in charge of production and stores with headquarters at Chicago, has been promoted to vice-president and treasurer in charge of the manufacturing, purchasing and treasury departments. John G. Abplanalp, production engineer, has been promoted to secretary to succeed Arthur L. Pearson, who has been elected assistant vice-president of the Bradford Corporation. Mr. Sinclair was born on April 12, 1878, at Chicago and entered railway service with the Chicago & Eastern Illinois in 1892. In 1893 he entered the operating department of the Columbian Intramural Railway at the Chicago World's Fair. At the close of the exposition he entered the service of the Union National Bank of Chicago where he remained until its consolidation with the First National Bank in 1900. He held several positions with the latter institution until September 1, 1910, when he became secretary and treasurer of Mudge & Company. On January 12, 1912, he was elected second vice-president and later was made first vice-president, which position he held until November 1, 1916. On the latter date he was elected executive vice-president, which position he has held until his recent promotion. Mr. Force was born on September 19, 1886, at Chicago and previous to his connection with Mudge & Company was auditor of a local concern operating a chain of stores in Chicago. He became associated with Mudge & Company in January, 1918, as assistant treasurer, and on March 15, 1918, was promoted to treasurer and was placed in charge of all purchases. On January 1, 1923, he was appointed assistant general manager in charge of production and stores in addition to his duties as treasurer, which position he has held until his recent promotion. Mr. Abplanalp was born on April 1, 1891, at LaCrosse, Wis., and in 1910 entered the employ of the Stayright Engine Company as a storekeeper and cost accountant, after serving in the United States Army as an officer in the infantry during the World War, he entered the employ of Mudge & Company as cost accountant. In 1921 he was appointed production engineer, which position he held until his recent promotion.

R. D. Sinclair

TRADE PUBLICATIONS

COOLERS.—The construction and advantages of the U-Fin cooler are outlined in Bulletin No. 1216 recently issued by the Griscom-Russell Company, New York.

STOKERS.—The new Frederick multiple retort underfeed stoker is described and illustrated in a 4-page pamphlet recently issued by the Combustion Engineering Corp., New York.

RADIAL BUFFERS.—The Franklin Railway Supply Company, New York, has recently issued Bulletin No. 326, descriptive of the application and maintenance of its line of radial buffers.

KING SANDER.—The King Sander for locomotives, locomotive boosters, motor cars, etc., is described in a four-page bulletin issued by the U. S. Metallic Packing Company, Philadelphia, Pa.

BELL RINGER.—The various methods of application of the Gollmar locomotive bell ringer are shown in an illustrated leaflet recently issued by the U. S. Metallic Packing Company, Philadelphia, Pa.

METALLIC PACKING.—King metallic packing for locomotive piston rods and the method of application of King packing rings are described in leaflets recently issued by the U. S. Metallic Packing Company, Philadelphia, Pa.

CARBIDE LIGHTS.—The Alexander Milburn Company, Baltimore, Md., has issued a 20-page, illustrated booklet descriptive of its various types of carbide lights, which are suitable for contractors, railways, mines and quarries.

WELDING AND CUTTING APPARATUS.—The Alexander Milburn Company, Baltimore, Md., has issued a 24-page, illustrated booklet, descriptive of its acetylene generators, torches, preheaters and other welding and cutting equipment.

STEAM HAMMERS.—The Morgan Engineering Company, Alliance, Ohio, has issued a 23-page bulletin, No. 22, briefly calling attention to a few of the prominent features of its steam hammers and showing the size and variety of hammers and equipment which it can furnish.

CARE OF OXYGEN AND ACETYLENE CYLINDERS.—This is the title of a 10-page booklet recently issued by the Air Reduction Sales Company, New York, which should be of general interest to those desirous of taking advantage of the great economies available through oxy-acetylene welding and cutting.

PRESSES.—A new line of self-contained broaching and assembling presses, the principal features of which are accurate control of ram speeds and pressures, the lack of accumulator, etc., are described in bulletin No. 30 recently issued by the Oilgear Company, Milwaukee, Wis. Detailed specifications are also included.

LOCOMOTIVE SPECIFICATIONS.—Notes, suggesting means that make for economy, increased locomotive capacity, reduced maintenance and decreased cost of conducting transportation, arranged for convenient use in the preparation of new locomotive specifications, are contained in the 1924 bulletin recently issued by the Franklin Railway Supply Company, Inc., New York.

AIR HEATERS.—The CEC air heater, a plate type of heater which has demonstrated its ability to increase furnace efficiency through the recovery of a portion of the heat ordinarily lost in flue gases, is described in a four-page folder, Bulletin AH-1, 1923, which is the first publication on air heaters issued by the Combustion Engineering Corporation, New York.

GRAPHIC INSTRUMENTS.—A complete new line of graphic instruments, type LR, is described in Bulletin No. 124 recently issued by the Esterline-Angus Company, Indianapolis, Ind. The removable inkwell and greatly increased damping are the more important new features of these instruments, from which both the inkwell and the pen can be removed, without tools, for cleaning and refilling.

WATERPROOF PAINT.—Under the title of "75 Years," Toch Brothers, New York City, have recently issued a large size, 12-page, illustrated booklet as a souvenir of their seventy-fifth birthday in the manufacturing of R. I. W. preservative paints and compounds. The first part of the text describes briefly the founding of Toch Brothers. This is followed by a partial list of well known structures protected by this company's products, as well as some of the principal accomplishments which have been achieved by them.

HIGH SPEED TOOLS.—A 226-page, illustrated handbook, Catalogue No. 40, has recently been issued by the Cleveland Twist Drill Company, Cleveland, Ohio, listing its various types of drills, reamers, sockets, counterbores, mills, etc. The catalogue is divided into a number of sections, each conveniently indexed so that it is a ready guide not only to the tools themselves, but also to their best and most economical use.

LEATHER PACKINGS.—The seventeenth and eighteenth installments of "Practical Facts About Belting" have been recently issued by the Charles A. Schieren Company, New York. The seventeenth installment outlines the uses, types, installation, etc., of leather packings for the making of tight joints, or for sealing against the pressure of gases or liquids. The eighteenth installment completes the series and is an index to the contents of the previous reprints.

AIR COMPRESSORS.—Specifications for Class WJ-3 angle-compound belt-driven air compressors and a description of the new improvements; namely, the "wafer" air valves now used on all sizes of these compressors, and the three-pass counter current intercooler formerly employed only when especially ordered, are given in Form 1594 2M 11-23 recently issued by the Sullivan Machinery Company, Chicago. These compressors are built in seven unit sizes, giving a range in single machines from 450 to 1,700 cu. ft. of free air per min., and in the twin unit up to 3,700 cu. ft., and have working pressures up to 120 lb.

ALL METAL CAR CONNECTIONS.—A four-page catalogue No. 83 has been issued by the Barco Manufacturing Company, Chicago, devoted to steam heat connections between passenger cars and pointing out the benefits to be derived from making these connections metallic. Tests are quoted to show that the metallic joints tend to promote safety, and in a specific case enabled the regulating valve pressure to be increased 50 per cent or from 61 lb. to 93 lb. With this initial pressure 5 lb. of steam was obtained at the rear of a 10-car train in 6 min. 21 sec. Metallic steam heat and air connections in stations and yards are also shown in several illustrations.

MEASURING RULES.—The Lufkin Rule Company, Saginaw, Mich., has issued a new catalogue, No. 11, devoted to the measuring tapes, rules and mechanical tools made by this company. The catalogue contains 166 pages of illustrations and information needed in ordering almost any kind of measuring instrument. It is divided into several sections, the first being devoted essentially to steel tapes, the second to woven tapes and the third to small mechanical measuring tools, such as micrometer calipers, combination squares, bevel protractors, calipers, thickness gages, etc. Subsequent sections show boxwood rules, spring joint rules and miscellaneous wood rules such as shrinkage rules, freight rules, lumber rules, etc.

LOCOMOTIVE CRANES.—The Brown Hoisting Machinery Company, Cleveland, Ohio, has issued a second edition of its booklet No. 10, entitled "Man Power Multiplied," describing and illustrating this company's No. 2 locomotive crane. The booklet, which is more complete than the first edition, enumerates various details of the crane and devotes considerable space to developing the various uses to which it is adapted. The majority of the illustrations show the crane in actual use on various kinds of work, while the remainder of the illustrations, which include a number of line drawings, have reference chiefly to showing the working parts and the dimensions. Full specifications covering the crane are included in the booklet, which comprises 20 pages.

ENGINE TENDER CONNECTIONS.—An attractively prepared catalogue, No. 42, has been issued by the Barco Manufacturing Company, Chicago, illustrating the Type 3-V engine tender connections for steam, air, oil and water, manufactured by this company. The catalogue points out the importance of reliability, efficient delivery of fluid, and freedom from roundhouse and shop maintenance in equipment of this kind, and on page 2 gives the results of exhaustive service tests of Barco connections compared to those of other types. Three charts are included, affording comparative data regarding the loss of pressure through various sizes of piping and types of connections between engine and tender. Drawings and instructions for the application of Barco Type 3-V connections are also shown in the catalogue.

PERSONAL MENTION

General

ROY W. HUNT has been appointed fuel supervisor of the Atchison, Topeka & Santa Fe, with headquarters at Los Angeles, Cal.

J. A. RABUCK has been appointed mechanical engineer of the Louisville & Nashville, with headquarters at Louisville, Ky., succeeding M. F. Cox.

J. J. HANLIN, superintendent motive power of the Southern district of the Seaboard Air Line, has been transferred from Savannah, Ga., to Jacksonville, Fla.

L. N. REED has been appointed mechanical manager of the New York, New Haven & Hartford with headquarters at New Haven, Conn., succeeding H. C. Oviatt, resigned.

R. D. SMITH, superintendent of motive power and rolling stock of the Boston & Albany, with headquarters at Boston, Mass., retired from active service at his own request.

M. F. COX, mechanical engineer of the Louisville & Nashville, with headquarters at Louisville, Ky., has been promoted to assistant superintendent of machinery, with the same headquarters.

C. J. SCUDDER, acting superintendent of motive power and equipment of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has been appointed superintendent of motive power and equipment, with the same headquarters.

B. N. LEWIS, assistant mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Fond du Lac, Wis., has been promoted to mechanical superintendent, a newly created position, with the same headquarters.

JOHN PULLAR, division mechanic on the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., has been promoted to acting mechanical superintendent of the Coast Lines, with headquarters at Los Angeles, Cal., succeeding H. S. Wall, who has been granted leave of absence.

W. S. BUTLER has been appointed superintendent of the newly created division of the Chesapeake & Ohio with headquarters at Russell, Ky. Mr. Butler entered railway service on the Chesapeake & Ohio as a machinist at Clifton Forge, Va., in January, 1895. From 1896 to 1898 he was employed as a machinist on the Norfolk & Western, the Southern, the Florida Peninsular and the Atlantic Coast Line and in 1899 returned to the Chesapeake & Ohio in the same capacity at Huntington, W. Va. Later he was transferred to Handley, W. Va., and was promoted to roundhouse foreman and general foreman. In July, 1904, he was promoted to assistant master mechanic at Lexington, Ky., and in January, 1905, was transferred to the Hinton (W. Va.) division in the same capacity. In November of the same year, he was appointed assistant master mechanic of the Huntington shops with jurisdiction over all departments and was promoted to master mechanic in June, 1910. In October of the following year he was given jurisdiction over the entire Huntington division and in August, 1912, the Hinton division was also added to his jurisdiction with headquarters at Hinton. In January, 1913, Mr. Butler was appointed master mechanic of the Huntington, Logan, Big Sandy and Ashland divisions with headquarters at Huntington and on November 15, 1920, was promoted to assistant to general superintendent of the Western general division, which position he was holding at the time of his recent promotion

W. S. Butler

FRED A. BUTLER has been appointed superintendent of motive power and rolling stock of the Boston & Albany, with headquarters at Boston, Mass., succeeding R. D. Smith. Mr. Butler was born on September 21, 1868, at Shrewsbury, Mass. He entered railway service on June 20, 1892, with the Boston & Albany as a locomotive fireman and in 1898 was promoted to engineman and subsequently served in the enginehouse at Beacon Park, Allston, Mass. In May, 1908, he was appointed road foreman of engines and in July, 1910, was appointed master mechanic of the Boston division. On November 1, 1916, Mr. Butler was appointed master mechanic of the Albany division, which position he held at the time of his recent promotion.

Master Mechanics and Road Foremen

G. E. NORRIS has been appointed road foreman of engines of the Middle division of the Atchison, Topeka & Santa Fe, with headquarters at Newton, Kan.

A. F. PERCIVAL has been appointed road foreman of engines of the Middle division of the Atchison, Topeka & Santa Fe, with headquarters at Newton, Kan.

G. P. GERDIN has been appointed road foreman of engines of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan., succeeding T. N. Murphy.

C. C. HAYMAN has been appointed road foreman of engines of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters in Argentine, Kan.

C. LEAT has been appointed road foreman of engines of the Oklahoma division of the Atchison, Topeka & Santa Fe., with headquarters at Arkansas City, Kan.

A. B. EDWARDS has been appointed assistant road foreman of engines of the Seaboard Air Line, with headquarters at Hamlet, N. C., succeeding B. Koontz, transferred.

J. S. WILLIAMS, general foreman of the Chesapeake & Ohio at Richmond, Va., has been appointed master mechanic, with headquarters at Clifton Forge, Va., succeeding C. B. Hitch.

F. A. PREWITT, general roundhouse foreman of the Kansas City Southern at Heavener, Okla., has been promoted to master mechanic, with the same headquarters, succeeding J. M. Pierce.

L. ERNEST, master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, at Minneapolis, Minn., has been promoted to general master mechanic, with headquarters at Shoreham shops, Minneapolis.

H. C. CASWELL has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with headquarters at East Buffalo, N. Y., succeeding F. C. Pickard, resigned.

SAMUEL RUSSELL, road foreman of engines of the Boston & Albany, with headquarters at Rensselaer, N. Y., has been appointed division master mechanic, with headquarters at West Springfield, succeeding F. A. Butler.

M. A. QUINN has been appointed master mechanic of the Syracuse & Utica division and the Ithaca branch of the Delaware, Lackawanna & Western, with headquarters at Binghamton, N. Y., succeeding H. C. Caswell.

J. M. PIERCE, master mechanic of the Kansas City Southern, with headquarters at Heavener, Okla., has been transferred to the Southern division, with headquarters at Shreveport, La., succeeding G. W. Lillie, who has resigned.

M. R. FEELEY has been appointed master mechanic of the Scranton and the Bangor & Portland divisions of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., succeeding B. H. Davis, assigned to other duties.

W. P. HOBSON, master mechanic of the Cincinnati, Ashland and Northern divisions of the Chesapeake & Ohio at Covington, Ky., has been appointed master mechanic of the Ashland-Big Sandy division, with headquarters at Ashland, Ky.

G. B. PAULEY, general foreman of the Chicago, Burlington & Quincy, with headquarters at Kansas City, Mo., has been promoted

to acting assistant master mechanic of the Galesburg division, with headquarters at Galesburg, Ill., succeeding D. Nott, granted leave of absence on account of illness.

C. B. HITCH, master mechanic of the Chesapeake & Ohio at Clifton Forge, Va., has been appointed master mechanic of the Cincinnati and Ashland divisions, also Northern division, with headquarters at Covington, Ky., succeeding W. P. Hobson.

J. W. HENDRY, assistant master mechanic of the Winnipeg division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Thief River Falls, Minn., has been promoted to master mechanic of the Winnipeg division, with the same headquarters.

F. M. ROBERTS, assistant master mechanic of the Missouri River division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Bismarck, N. Dak., has been promoted to master mechanic of the Missouri River division, with the same headquarters.

Car Department

J. L. ROCHUS, car foreman of the Missouri-Kansas-Texas at Sedalia, Mo., has been transferred to Franklin, Mo.

W. J. WILLIAMS, car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Prescott, Ariz., has been transferred to Gallup, N. M.

J. L. CROOKS has been appointed car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Prescott, Ariz., succeeding W. J. Williams.

F. W. SPRINGER, assistant foreman of the Nashville, Chattanooga & St. Louis at Nashville, Tenn., has been promoted to gang foreman, succeeding Hunter Whitaker.

HUNTER WHITAKER, gang foreman of the Nashville, Chattanooga & St. Louis, at Nashville, Tenn., has been appointed assistant general foreman, car department.

H. HALVORSON has been appointed assistant superintendent, car department, Chicago division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Fond du Lac, Wis.

G. T. DUNN, general foreman of the car department of the Nashville, Chattanooga & St. Louis at Nashville, Tenn., has been appointed general foreman, car department, for the system, retaining jurisdiction over the department at Nashville shops.

Shop and Enginehouse

R. D. KOCHER, assistant general foreman of the Scranton, Pa., shops of the Delaware, Lackawanna & Western, has been promoted to general foreman.

J. E. POWELL, general foreman of the locomotive and car department of the Chicago, Burlington & Quincy at Savannah, Ill., has been transferred to East St. Louis, Ill.

E. C. GORDON, assistant road foreman of engines of the Grand Rapids division of the Pennsylvania System, has been transferred to the Toledo division, succeeding E. A. Burchiel.

O. E. MAXWELL, road foreman of engines of the Ft. Wayne division of the Pennsylvania System, has been transferred to the Mackinaw division, succeeding E. J. Strong, pensioned.

BEN MCNEE, a machinist at Dayton Bluff, Minn., has been promoted to night foreman of the Chicago, Burlington & Quincy, with headquarters at Savannah, Ill., succeeding H. G. Wright.

OTTO STURM, general foreman of locomotive repairs of the Delaware, Lackawanna & Western at Scranton, Pa., has been promoted to general enginehouse foreman, succeeding M. A. Quinn.

H. G. WRIGHT, night foreman of the Chicago, Burlington & Quincy at Savannah, Ill., has been promoted to day roundhouse foreman, with headquarters at Dayton Bluff, Minn., succeeding George Wilson.

GEORGE WILSON, day roundhouse foreman of the Chicago, Burlington & Quincy at Dayton Bluff, Minn., has been promoted to general foreman of the locomotive and car department at Savannah, Ill., succeeding J. E. Powell.

E. L. BONHOFF, enginehouse foreman of the Pittsburgh division of the Pennsylvania System at Pitcairn, Pa., has been appointed general foreman, maintenance of equipment department, Pittsburgh division, with headquarters at Pittsburgh, Pa.

JOHN R. LANCASTER, whose appointment as superintendent of the locomotive shops of the Delaware, Lackawanna & Western at Scranton, Pa., was announced in the January issue of the *Railway Mechanical Engineer,* was born on August 14, 1882, at Lebanon, Ky. In June, 1903, after graduating from the University of Kentucky as a mechanical engineer, he entered the employ of the Lake Shore & Michigan Southern as a special apprentice, subsequently serving as a machinist, inspector of material and assistant engineer of tests. In January, 1912, he resigned to take charge of the maintenance of shop machinery and equipment at the Scranton, Pa., shops of the Delaware, Lackawanna & Western. In August, 1915, he was appointed erecting shop foreman, serving in this capacity till September, 1917, when he became general foreman. He held this position until his recent appointment to superintendent of shops.

J. R. Lancaster

Purchasing and Stores

J. R. ORNDORFF has been appointed division storekeeper of the Baltimore & Ohio, with headquarters at Glenwood, Pa.

J. H. SKAGGS has been appointed storekeeper of the Atchison, Topeka & Santa Fe, with headquarters at Waynoka, Okla.

A. HAAG, general storekeeper of the Alaska Railroad, with headquarters at Anchorage, Alaska, has resigned and his office has been abolished.

V. N. DAWSON, division storekeeper of the Baltimore & Ohio Chicago terminal, has been transferred to Cincinnati, Ohio, succeeding R. R. Jackson.

A. SCHIPPER has been appointed assistant division storekeeper of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., succeeding C. S. Jones.

R. R. JACKSON, district storekeeper on the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been appointed district storekeeper on the Wabash, with headquarters at Decatur, Ill.

A. C. DOUGLAS, assistant general purchasing agent of the Canadian Pacific, with headquarters at Montreal, Que., has been appointed purchasing agent, with headquarters at Vancouver, B. C.

B. W. ROBERTS, purchasing agent of the Canadian Pacific at Vancouver, has been promoted to assistant general purchasing agent, with headquarters at Montreal, succeeding A. C. Douglas.

H. P. BUCHENERY, division storekeeper of the Stockton division of the Southern Pacific, with headquarters at Tracy, Cal., has been transferred to the Tucson division, with headquarters at Tucson, Ariz., succeeding V. R. Naylor.

V. R. NAYLOR, division storekeeper of the Tucson division of the Southern Pacific, with headquarters at Tucson, Ariz., has been transferred to the Sacramento division, with headquarters at Sacramento, Cal., succeeding A. E. Meahl, who has resigned.

C. S. JONES, assistant division storekeeper of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., has been promoted to division storekeeper of the Stockton division, with headquarters at Tracy, Cal., succeeding H. P. Buchenery.

Obituary

P. P. Huston, formerly purchasing agent for the Louisville & Nashville, who retired from active service in 1912, died in Louisville, Ky., on January 18.

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Vol. 98 March, 1924 No. 3

Successful Shop Management

Probably no competition that we have ever held presented a more difficult problem to the judges than did the one on shop management—this because of the great differences in the character and contents of the contributions. The first and second articles have already been published. One of the contributions which will be found elsewhere in this issue, prepared by A. Montangie, was highly commended by the judges. It deals with the psychological factors in management and is exceedingly well written and logically arranged. It is noteworthy, also, for another reason—it is one of the very few contributions to our competitions which we have ever received from a foreign land. The writer is connected with the mechanical department of the Belgian State Railways, and in his letter of transmittal indicates that he has had an opportunity of trying out the principles outlined in his article with excellent results. For these reasons the article should possess a peculiar interest for our readers.

Machine Shop Competition Closes April 1

The closing date for submitting contributions to the machine shop production competition is April 1. Details of this competition were announced on page 70 of the February *Railway Mechanical Engineer*. Since machine shop work on rods, motion parts, and driving boxes constituted three of "the key jobs of all those capable of being organized on a production basis," it is hoped that many shop foremen and others interested in the rapid, orderly handling of this work will describe their methods for the mutual benefit of all our readers. What is the correct arrangement of machinery? What machine is best adapted for each important operation? Most important of all, how are your men organized for handling the work? Are you getting the output you ought to from your rod, motion work, or driving box gangs compared with the number of men employed in each? If you are, tell us about it and perhaps win one of the $50 prizes. If your article is not awarded a prize, but is published, in whole or in part, it will be paid for at our usual rates. The judges will base their decision on the practical value of the material in the article. Don't forget the closing date is April 1, and send all contributions to the *Railway Mechanical Engineer*, 608 S. Dearborn street, Chicago, Ill.

Elimination of Waste Contest Prize Winners

In our October and November issues, we announced a prize contest for the two best papers on the elimination of waste, submitted before November 15. The conditions of the contest called for the description of specific instances where waste, either of material, labor or the use of facilities, had been eliminated, and the prizes were to be awarded on the basis of the practical value of the suggestions. A surprisingly small interest was shown in this subject and only two papers were submitted. These papers approach the subject from quite different viewpoints. One outlines a change of practice with respect to one locomotive part, which has effected a quite definite saving. The other calls attention to a fundamental cause of serious waste, which, however, is beyond the control of mechanical department supervisors and at least some of the executives themselves. For the reason that the former adheres more closely to the conditions outlined, the first prize has been awarded to the author of that paper, Millard F. Cox, mechanical engineer, Louisville & Nashville, and the second prize to D. M. Raymond, car foreman, Union Pacific, whose paper is worthy of the most careful consideration even though it is devoted to pointing out faulty conditions rather than to suggesting a practical means of improving them. The papers will appear in early issues.

Adopt Standard Truck Levers

A number of years ago, after careful investigation followed by concerted agitation on the part of quite a few men responsible for the maintenance of air brake apparatus, several leading railroads adopted standard truck levers and specified such levers on all orders for new freight equipment. With varying designs of trucks, it is not, of course, possible to use a single length of lever in all cases; neither is it possible with all designs to make the live lever and the dead lever on a truck of the same length. However, it is fundamntal and universal to make both the live and dead levers on a truck of the same proportion. Thus, if the proportion adopted as a standard was 4 to 1, the live lever might have lengths of 7 in. and 21 in. and the dead lever 6½ in. and 19½ in. The adoption by a road of a standard proportion for truck levers and using such a standard on repeated orders for freight cars, tends to reduce the possibility of the substitution of wrongly proportioned levers when making repairs and thereby contributing to the possibility of slid flat wheels. Such a mistake as this has been made far too many times by the men who are available for such work. Should the mistake, however, be one simply of length and not of proportions, the distribution of brake shoe pressure would not be disturbed, and such a substitution would generally be advisable if it expedited repairs. Furthermore, it would not be necessary to carry such a varying stock of spare levers at many points or levers that have to be drilled before they can be applied. The proportion of 4 to 1 mentioned may not be considered by all roads as the most desirable one; some roads adopted 3½ to 1 and some as low even as 3 to 1, but it is generally conceded that the proportion should not exceed 4 to 1 in order to avoid excess angularity.

A recent examination made it evident that at the present time many large systems were not adhering to any fixed standard proportion. This point apparently was given due consideration, however, by the A.R.A. Committee on Car Construction for on the drawings for the standard box car the truck levers are shown as 7½ and 18¾, a proportion of

3½ to 1. All roads which thus far have not adopted standard truck levers should consider the advisability of the adoption of this proportion for the truck levers of all new freight equipment. Even those roads which have only partially adopted some other standard ratio would do well to consider the advisability of specifying a ratio of 3½ to 1 on future orders and thus gradually reduce the confusion that now exists in maintaining cars in interchange.

Broadening the Vision of Apprentices

Among the excellent practical suggestions for improving apprentice training made by F. O. Robinson in his paper which was awarded honorable mention in the regular apprentice competition, and which is printed on another page of this issue, is one of a rather unusual nature. It is suggested that business men and educational authorities be brought in occasionally to speak to the boys on topics outside of shop subjects and which will tend to broaden their viewpoints and help to develop their characters along the right lines.

While this has been done in a few instances, and in a more or less limited way, it will undoubtedly come to some people as a rather radical suggestion. The value of these things to the boys can hardly be over-estimated, particularly where the shops are so located that such talks are infrequent in community or other gatherings which may be open to the apprentices. The value of these talks is greatly increased when they are given to the apprentices as a group, and particularly when they are followed up by open discussions, or at least an opportunity is given of asking questions. There are many business and professional men who are splendidly fitted to be helpful in speaking informally to a comparatively small group of this sort and who would feel it not only a duty but a privilege to be helpful in this way.

Is this suggestion practical? Is it worth while? We shall be glad to hear from any of our readers who have attended such meetings and have been helped by them. Please don't stand on ceremony, but drop a note to the editor about your experiences. If Mr. Robinson and the other men who write on apprenticeship, or on other subjects, make worth-while suggestions that you can support from your experience, let our readers know and thus help the good work along. If, on the other hand, you believe the suggestions are not practicable or will not be helpful, let our readers know, in order that others may be kept from making useless mistakes.

Enginehouse Foremen Overworked

No man can do his most efficient work unless he keeps himself in prime condition. This he cannot do if he works unreasonably long hours every day and if he is forced to work every day in the week. This was clearly demonstrated by the report which was made under the auspices of the Federated American Engineering Societies on the Twelve-Hour Shift in Industry. The enginehouse is in most cases the neck of the bottle in railroad operation. Larger and larger locomotives have been introduced, and the number of locomotives has been increased, but without a corresponding increase in enginehouse size and facilities. The average enginehouse foreman is worked almost to the limit of his endurance. These men are giving a remarkable account of themselves, but are they being given a square deal, and might they not in many cases be able to handle their positions far more efficiently if their working conditions were improved and greater recognition given to their importance in the organization? The following quotation speaks for itself.

"The roundhouse foremen on this and other lines are required to work eleven hours a day, seven days a week. A man who stays close to the work and watches closely is certainly under a mental strain, and eleven hours is too long to stand it every day in the week. Dispatchers and operators are limited in their hours of service for a good reason, but a roundhouse foreman can overlook a detail and wreck a train or explode an engine. I would like you to show the railroads that it would be profitable to work the engine terminal foremen not over nine hours a day at 50 per cent above the highest paid mechanic. The world at large, especially industries, has found that mechanics do not perform efficiently when worn out, so why should a roundhouse foreman perform even satisfactorily at mechanics' pay and long hours?"

In this connection our readers may be especially interested in the article on "The Fatigue Element in Accident Prevention," which will be found elsewhere in this issue.

Waste in Car Repairs— A Competition

Did you ever take a look into some car repairman's shanty and see a keg of bolts or nails that had been broken open with a maul and the contents strewn all over the floor? If you did, perhaps a further inspection revealed an old box full of lag screws, uncoupling lever links, a few air hose couplings, along with other odds and ends of usable material. In walking around the shanty, you may have stumbled over a varied assortment of couplers, knuckles, and "what not," thrown together in a pile or half buried in the ashes. Inspection periods on this line were either long and far between, or the responsible car department officer did not consider this car repair point important enough to bother with. In a stroll through the country, you may have notcied a front gate fastened with a bolt and staple intended for a box car and as you entered the village, you noted further that the device seemed to be quite popular for garage and barn doors, as well as gates. Upon recollection, you remembered that there was a box of door fastenings among the pile of junk beside the car repairman's shanty.

A few days later, you might have had occasion to visit another outlying car repair point. There was the same style of shanty. Yet there were evidences of an attempt to keep the material in some sort of orderly arrangement. The foreman evidently appreciated the advantages to be obtained by doing his work in an orderly fashion. There was a platform outside for storing couplers, brake beams and other heavy material; racks for tie rods, brake rigging and air cylinders, and bins for small parts. It seemed there was a place for everything and everything was in its place, yet the bins and racks were not arranged in logical order. You might have continued your journey around the yard and down the repair track and noted the apparatus and various appliances used in the work, and you might have had your doubts as to some of them getting by the safety inspector. However, you must have gotten a lot of good ideas as to the kind of facilities and practices that would improve conditions at these outlying car repair points.

In order to give you just the opportunity to put some of these ideas across, the *Railway Mechanical Engineer* is offering two prizes: one of $50 for the best article, and another of $35 for the second best article on the elimination of waste at outlying car repair points. Even if you should not win either of the two prizes, there is a chance of your article being published if it contains some good ideas or suggestions. In case the article is published, it will be paid for at the regular space rates. Articles will not be judged on their literary merit, but on the value and practicability of the methods described.

From the standpoint of economy and efficiency, this subject is of timely importance. How do you think such conditions can be improved? Would you propose standard buildings and methods of storing material for an entire sys-

tem? What limitations would you impose as to the kind of work to be done at outlying points? There are a number of questions that ought to be answered and perhaps you may think that your road has solved them all. If so, here is your chance to tell us about it. Photographs and drawings go a long way towards telling other folks what you have in mind, and if you really desire to convince the other fellow, be sure that your article is well illustrated. Papers entered in this competition must be mailed on or before May 1. Address them to 30 Church Street, New York.

Evidence of Unfair Usage

Approximately one-half of the cases that are brought before the Arbitration Committee for settlement involve some application of Rule 32. The majority of the cases do not require an interpretation of the rule, but are primarily questions of fact relative to which the disputing parties cannot agree. It is rather difficult to determine the circumstances that caused the damage and, in order to decide the case, it is necessary that a complete knowledge of all the facts be had. The failure to collect complete evidence at the time of the accident is noticeable in practically every case where the question of unfair usage comes up.

Rule 32 is quite specific as to what constitutes unfair usage and the decisions of the Arbitration Committee show a tendency to assume that the existence of any of the conditions cited in the rule is proof that this condition is the primary cause of the damage. However, this tendency does not exist in cases where derailment, wrong signals or lack of rider protection are given as the cause of the accident. As was brought out in a previous editorial in the *Railway Mechanical Engineer,* there are cases of damage for which this strict interpretation of the rules makes the handling line responsible, where equipment of better construction undoubtedly would not have failed. It seems, therefore, that the burden of proof is placed to a large extent on the handling line. As a matter of policy, it should, in such cases, collect proper and sufficient evidence to prove without a doubt that none of the conditions named in Rule 32 exist. Until the railroads take cognizance of the fact and educate their employees to the importance of obtaining complete evidence at the time of the accident, there probably will continue to be little prospect of the handling line obtaining a favorable decision.

Support Railway Clubs and Associations

The educational possibilities of railroad clubs and minor mechanical associations are greater than generally recognized, and higher mechanical officers can do much towards the more complete realization of these possibilities by encouraging active interest and membership in such organizations. Their prime object is certainly worthy—to stimulate among railroad men an alert and intelligent conception of their duties and responsibilities in our highly developed transportation system. Several outstanding advantages of membership in these organizations come to mind.

Co-operation results from personal contact. Co-operation means working and acting together in the promotion of the same end, and this end, as far as mechanical department work is concerned, consists of keeping cars and locomotives in condition for the safe, economical and prompt transportation of freight and passengers. One of the prime requisites of co-operation is a clear understanding of mutual problems and how to meet them, and the best way to get such a mutual understanding is by membership in, and faithful attendance at the meetings of the various associations covering the different branches of railroad mechanical work. It cannot be denied that many troublesome controversies are avoided and difficult problems surmounted to the satisfaction of all concerned whenever a group of men interested in the same line of work can get together and talk things over. It would frequently take an indefinite period, if, indeed, it did not prove impossible, to bring about the same result by correspondence.

Uniform practice and interpretations are promoted. The rules governing the interchange of, and repairs to cars, for example, are from year to year becoming more intricate as a natural result of changing conditions, improvements of equipment and increased traffic requirements. No agency plays a more important role in the proper and sane interpretation and application of these rules than the car inspectors' and car foremen's associations by their "get together" meetings. The influence of such organizations as the Chicago Car Foremen's Association with a membership of over 10,000 receiving the proceedings of the monthly meetings may readily be appreciated. Full and frank discussion, and information from authentic sources explaining the necessity of apparently inconsistent requirements of the rules, result in many leaving the meetings with a more definite understanding of the intent and spirit of the rules. Also many important modifications, based on the experience of the membership, result from the recommendations made by these associations.

Education is afforded in the various phases of mechanical work. Papers on technical and practical subjects, presented at the meetings by authorities on such subjects and freely discussed, are an education in themselves and help to broaden association members who are not so familiar with, but in a more or less general way have supervision over, the particular phase of work under discussion. The subjects selected are pertinent to mechanical department activity and the attempt is made not to have them of too technical a nature for the membership to whom they are presented. When such papers, and the discussion following their presentation, are published and distributed to the membership they become a permanent and valuable source of information for future reference.

The railroads are benefited. If the benefits of mechanical association membership are great to the individual they are also of prime importance to the railroad which employs him. Few things in life give a man more satisfaction and genuine pleasure than "knowing his stuff and doing it" and nothing is more conducive to efficiency and morale in any organization than encouragement from the "higher ups" to their subordinates on the firing line in their endeavor to gain a keener knowledge of their chosen line of work.

Railway Club Discusses Shop Scheduling

At the December meeting of the Western Railway Club, L. C. Bowes, production engineer of the Rock Island, read a paper on "Locomotive Scheduling and Production Control," dealing with the system recently established at Silvis shops (published in five installments in recent issues of the *Railway Mechanical Engineer*). The intense interest in the subject of scheduling work through locomotive repair shops was shown by the fact that at the time of adjournment so many members wanted the floor that it was decided to continue the discussion at the March meeting.

There is good reason for the interest in shop schedules. Railroad shop costs are unquestionably high and in too many cases it is not known just how high they are. Mr. Bowes' paper showed that, with the schedule in operation during a period of five months, the number of man-hours required to give locomotives heavy repairs at Silvis shops were reduced 33 per cent and the actual locomotive output increased 23 per cent. The days of hit-or-miss shop operation are numbered and it is no longer sufficient to call foremen to a weekly meeting and give them a list showing the order in which locomotives are to be turned out during the next week. This method savors of the lack of system found in a certain railroad shop

not so long ago. Noting the large amount of shop order work scattered about the machine shop floor, the foreman was asked how he knew on which shop order to work first. He replied, "I wait until they wire me for it."

Multitudinous schedule forms and unnecessary detail are highly undesirable and form perhaps the main reason why some railroad shopmen of the old school still cling to their objections to shop scheduling. Experience shows, however, that between the extremes of too much and too little system, there is a happy medium, the application of which means an important increase in shop output at decreased unit cost.

The following is an actual case, the facts regarding which can be substantiated. A certain railroad shop in 1909, previous to the installation of any schedule system, required from 20 to 30 days to give a locomotive heavy repairs. A shop schedule, known as the Gardner System, was installed and operated, with only partial success, from the drafting room. A schedule man was developed who spent his entire time in the shop and by 1913 the repair time had been reduced to 14 days. In 1914 a new modern-equipped shop was completed for this railroad at another point and, with essentially the same schedule system to co-ordinate properly the operations in the new shop, the time for giving a locomotive new flues and heavy repairs to machinery was reduced to eight working days. The reduced unit cost in repairing these locomotives can be readily appreciated and in addition they were returned to revenue-earning service with what was probably a minimum loss of time consistent with thorough repairs.

It is perfectly possible to install a schedule system without an objectionable number of forms to fill out and clerical work to unload on the foremen. Correspondence can and should be reduced 50 per cent in many railroad shops. One superintendent of a shop turning out over 40 locomotives a month knows how the work is progressing on every locomotive in the shop by means of a small board on his office wall. This man writes not more than six letters a week to his foremen and visits the shop himself only at infrequent intervals. Who will say that the shop schedule does not relieve him and his foremen of details and allow them to perform their real function of supervising?

The question of shop scheduling is strictly up to foremen and shop officers. If they install the right system and believe in it, it will save them much detail and hundreds of steps daily. If they don't believe in it and give it hearty support, it can never be a success.

New Books

MASTER BLACKSMITHS' PROCEEDINGS. *Edited by William J. Mayer, Secretary, 2347 Clark Avenue, Detroit, Mich.* 147 *pages*, 5½ *in. by* 8 *in. Bound in cloth.*

This book contains a report of the proceedings of the twenty-seventh annual convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, August 21, 22 and 23, 1923. The report of the proceedings has been carefully edited by Mr. Mayer and many papers are included which will be of interest and value to blacksmith foremen and others interested in the work of the blacksmith department. Considerable attention, for example, is given to the respective fields of the Thermit, oxyacetylene and electric welding processes in railroad shops. The book is illustrated.

SHAPE BOOK OF THE CARNEGIE STEEL COMPANY. 346 *pages*, 5 *in. by* 7½ *in., illustrated. Flexible binding. Published by the Carnegie Steel Company, Pittsburgh, Pa.*

This volume is the ninth edition and is available to users of steel. The new edition is the result of a thorough check and revision of all the sections rolled by the Carnegie Steel Company on its shape, rail, bar and plate mills, and while no important changes have been made in the regular sizes of structural and bar mill sizes of beams, channels, angles, tees and zees, a number of changes have been made in the large number of special sections rolled by that company, such as concrete reinforcement bars, window and casement sections, automobile rim sections and other miscellaneous bar mill sections. Certain rails and splice bar sections, which have become obsolete since the issue of the preceding eighth edition, have been eliminated in the present issue.

What Our Readers Think

Three Cylinder Locomotives

LONDON, Eng.

TO THE EDITOR:

The letter from George L. Clouser in the December issue of the *Railway Mechanical Engineer*, was read with interest. If my recollection serves me rightly, the Erie & Wyoming Valley had a three-cylinder simple locomotive in service some 20 years ago. It is my impression that this locomotive was of the 2-6-0 type and had three cylinders, the diameter of which was 17 in. A. M. BUSHELL.

(While the first conception of the three-cylinder locomotive was probably of English origin, the first application appears to have been made in 1847 on the Philadelphia, Wilmington & Baltimore. About 1880 the Pennsylvania Coal Company built four small three-cylinder switch engines for service around their mines. Another locomotive of the 4-4-0 type with 15-in. cylinders was built in 1892 for the Erie & Wyoming Valley, now part of the Erie system. In 1894 the Baldwin Locomotive Works built three more locomotives of the 2-6-0 type for the same road. These had 17-in. by 24-in. cylinder and are the ones referred to by Mr. Bushell.—Editor.)

"What Is Wrong with This Picture?"

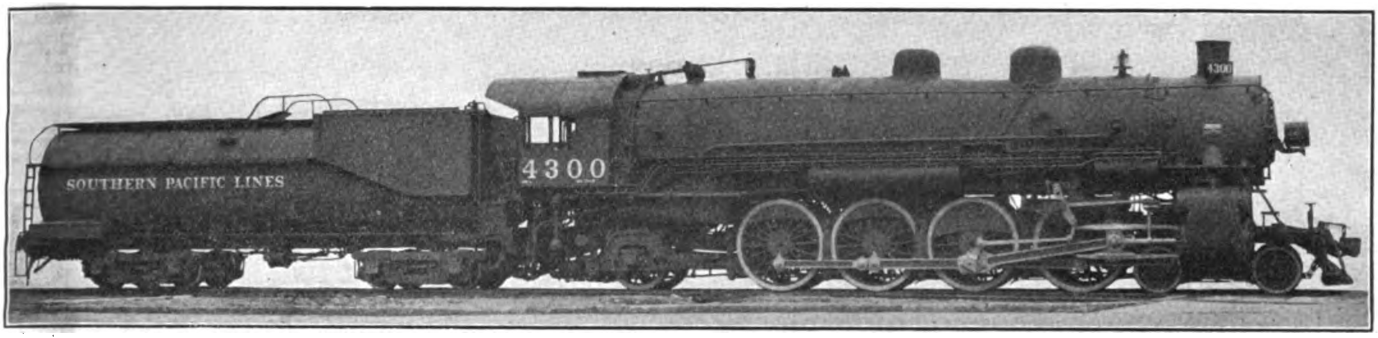
CHICAGO.

TO THE EDITOR:

I was much interested in the article on welding and cutting on page 88 of your February issue, particularly in the gentleman shown welding on pages 88 and 90. I must say that his attitude of perfect complacency, benign and bland assurance and calm repose, as he stands with head erect, fine beaver hat sitting quite pleasingly over a smiling face, with immaculate white collar, a fine fitting coat and well creased trousers, represents an epic—a wonderful tribute to the rapid advancement in the art and science of the use of the acetylene torch. Perfect indeed has this art been developed—goggles needed no more. There he stands, with his steady ungloved right hand welding a cast steel truck side. How simple and easy it must be. We find still more to admire, for, on page 90, he is shown to be ambidextrous: with his left hand, also ungloved, here we see him welding a coupler.

So interesting a study in the autogenous art should not lightly be passed by, hence I hasten to pay my tribute to the gentleman himself and to the artist and the editor who present him. OBSERVER.

(With apologies to the man in the photographs and to the artist who took them, we cannot refrain from printing the comment of our correspondent on the etiquette of the torch. —EDITOR.)



The Locomotive That Makes the 815-Mile Run

Southern Pacific 4-8-2 Type Locomotives

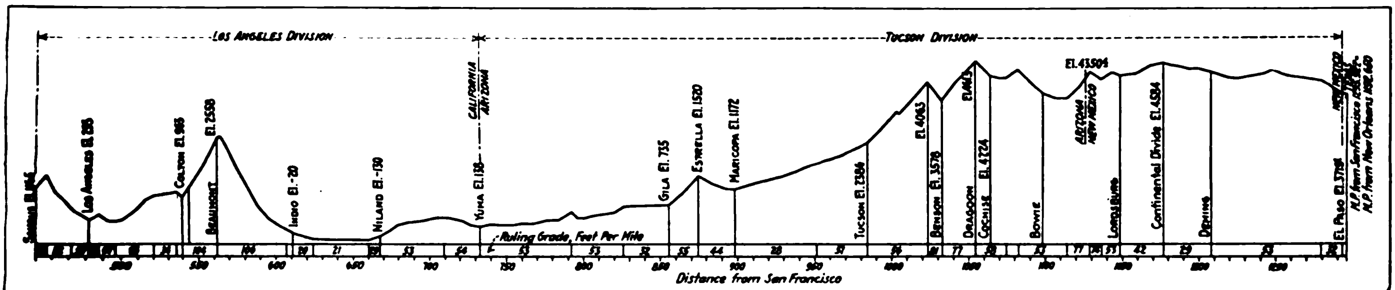
Designed To Haul Trains of Twelve Passenger Cars on Two Per Cent Grades and Run 815 Miles

EARLY in 1921 the Southern Pacific placed in service a number of powerful 4-6-2 type locomotives* that hauled 11 heavy passenger cars on a 1.5 per cent grade and established a record for long locomotive runs. These locomotives have been regularly hauling passenger trains between Ogden, Utah, and Sparks, Nev., a distance of 536 miles, and have averaged better than 10,000 miles per month, fully meeting the expectations of the Southern Pacific in adopting a longer stroke for superheated passenger locomotives, thus keeping down cylinder clearances and obtaining a more economical steam consumption. In this respect, the Southern Pacific has taken the lead.

This company has recently made another advance by placing in service ten 4-8-2 type locomotives to haul their heavy passenger trains between Los Angeles, Cal., and El Paso, Tex. These locomotives were especially designed for this long run over that difficult mountain and desert territory, a distance of 815 miles, which is made without changing locomotives, thus establishing a new record for long locomotive runs. It is anticipated that these locomotives will average about 12,000 miles per month.

The general design and specifications for these locomotives were worked up under the supervision of George McCormick, general superintendent motive power, and Frank E. Russell, assistant mechanical engineer, the design being completed and details worked out with the American Locomotive Company which built the locomotives. The outstanding characteristics sought in this design were maximum tractive power within the weight limits and ample boiler capacity for the long sustained runs. This required refinement in design to provide ample strength with minimum weight necessitated the use of materials of high tensile strength for many parts.

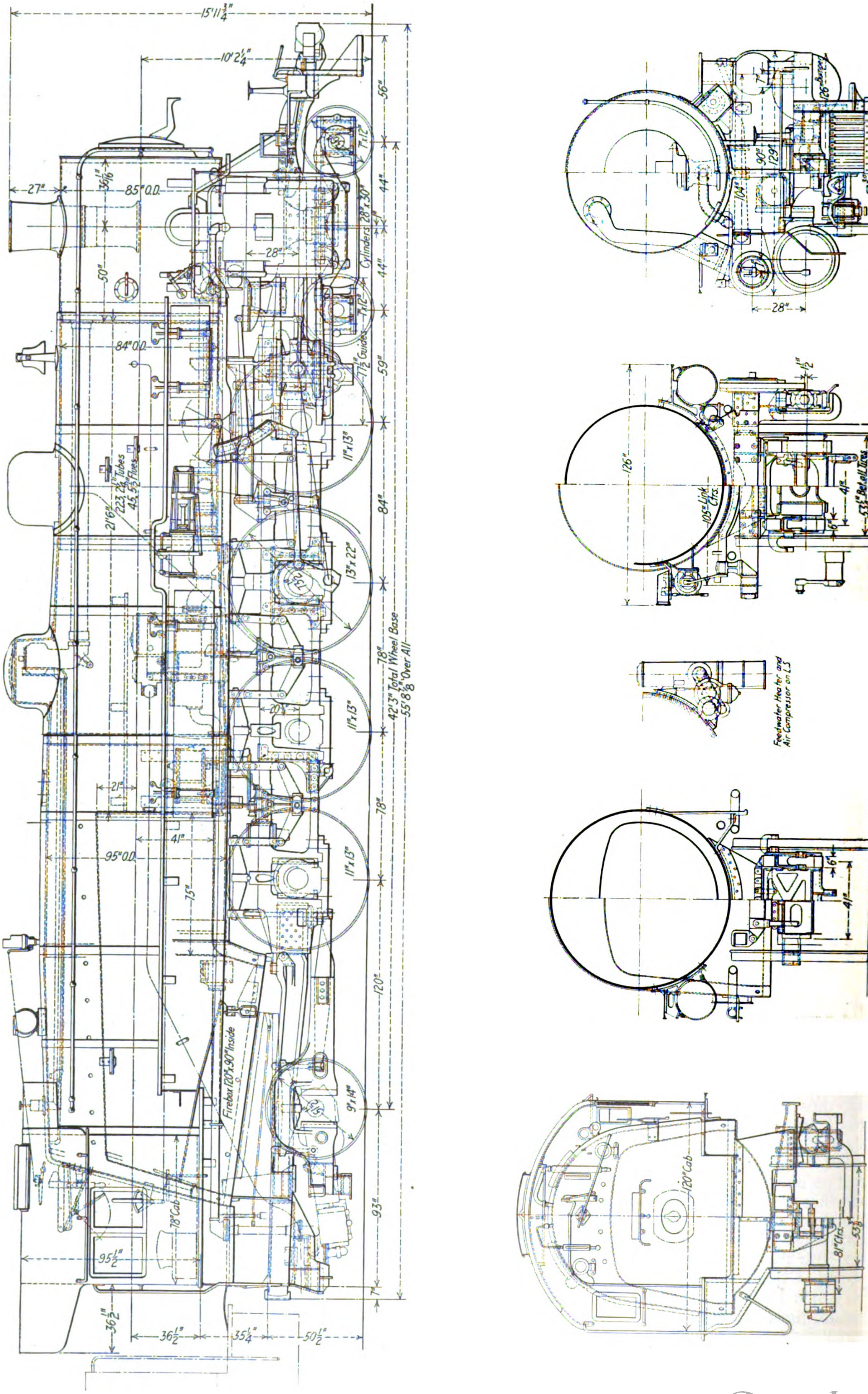
The character of the territory over which these locomotives are operating is shown on the accompanying profile. Grades of 2 per cent occur from Colton to Beaumont going east and from Indio to Beaumont going west. Also, from Tucson to Dragoon going east there are grades of 1.5 per cent. Previously the through passenger trains were hauled over the districts which have the heaviest grade by 2-8-2 type locomotives, and by 4-6-0 type locomotives and 4-6-2 type locomotives where the grades are lighter. With trains varying from 8 to 12 cars, the time card calls for schedules for Sunset Limited trains of 24.2 miles per hour from Colton to Beaumont and of 26.2 miles per hour from Indio to Beaumont. From Tucson to Dragoon the schedule is about 30 miles per hour. Most of the remaining portions of the line consist of grades of approximately one per cent, the schedules varying from 38 to 42 miles per hour. It is expected that the new 4-8-2 type locomotives, which have a high sustained steaming capacity, will bring the maximum and minimum operating speeds nearer to the average, which will materially reduce the maintenance costs of both locomotives and track.



Profile of the Southern Pacific Between Los Angeles and El Paso, Where the Run of 815 Miles Is Made

These 4-8-2 type locomotives have a total weight of 368,000 lb., of which 246,000 lb. are on the drivers. The maximum tractive force is 67,660 lb. with the booster, and 57,510 lb. without the booster, the ratio of adhesion for the drivers being 4.28. Using Cole's ratios as a basis of comparison, they have a maximum cylinder horsepower capacity of 2,965 and a boiler capacity of 103.4 per cent, including the increase obtained by the use of the feedwater heater. This high percentage of boiler capacity indicates that it can supply the cylinders at high speeds without forc-

* For a description of these locomotives see *Railway Mechanical Engineer*, August, 1921, page 481.



Elevation and Cross Sections of the Southern Pacific 4-8-2 Type Locomotive

ing. The boiler was designed with the largest proportions possible to obtain ample steaming capacity and, at the same time, to keep the wheel load on the track within safe limits.

Boiler and Smoke Stack

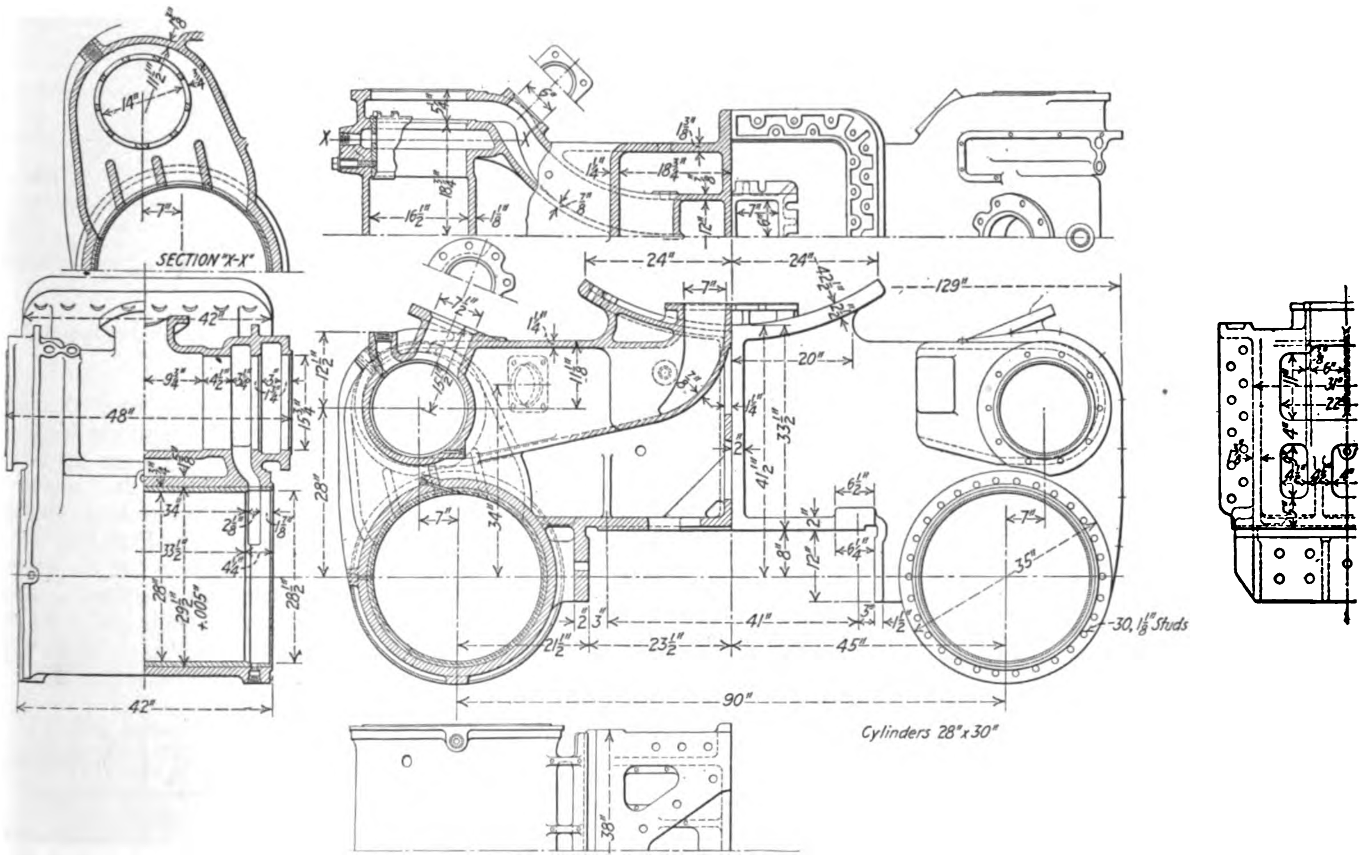
The boiler is conical in form with an inside diameter of 82 7/16 in. at the front barrel course, increasing to 93¾ in. at the combustion chamber course. The firebox measures 121 1/16 in. by 90 in. inside of sheets at the mud-ring and includes a combustion chamber 75 in. in length, which provides for tubes 21 ft. 6 in. long. The steam space above the crown sheet is 30 in. at the back end and 25¼ in. at the front end. The Type A superheater consists of 45 units with a superheating surface of 1,162 sq. ft. The boiler shell is of 25/32 in. material for the first course and ⅞ in. for the second and third courses; and the wrapper sheet is ½ in. thick. The firebox and combustion chamber sheets are ⅜ in. excepting the inside throat connection which is 9/16 in. thick and welded in between the side sheets and the combustion chamber. The firebox is fitted with F. B. C. welded universal sleeves and reduced body staybolts.

The smokestack is a new design of the railroad company. It consists of four iron castings, assembled in such a manner that the extension of the stack in the smokebox can be easily and quickly removed. The castings forming the extension, which are most subject to wear, can be replaced by new castings with very little trouble and without disturbing the alinement of smokestack and base. The casting forming the lower portion of the extension is so designed that the height of the bell above the exhaust nozzle may be increased or decreased to give the best draft conditions. This feature also makes the stack applicable to a number of other types of locomotives.

Cylinders and Running Gear

The cylinders follow the American Locomotive Company's light design, except that the exhaust passages have been enlarged considerably above those which are in general use. The size of the opening at the top of the saddle is 12 in. by 7 in., providing unrestricted exhaust passages up to the exhaust nozzle. The exhaust stand is secured by twelve 1⅛-in. tee-head bolts. The exhaust passages of the cylinders are extended 4 in. above the cylinder saddle and provided with a 1⅛-in. flange, well reinforced with ribs, extending down to and joining the cylinder saddle. This construction eliminates troubles experienced in maintaining a tight joint, the absence of which interferes with the draft of the locomotive. The cylinders provide for outside steam pipes and connections for superheated steam to the Franklin Railway Supply Company's Type C-1 booster and exhaust steam to the feedwater heater. The depth of the casting over the frame section gives a very strong construction with the minimum of weight.

The steam distribution is controlled by 14 in. piston valves having a maximum valve travel of 7 in., a constant lead of ¼ in., a steam lap of 1¼ in. and an exhaust clearance of 3/16 in. The piston valves are propelled by a direct Walschaert gear, adjusted to give equal cut-off at 55 per cent stroke. The valve gear is controlled by an Alco power reverse gear.

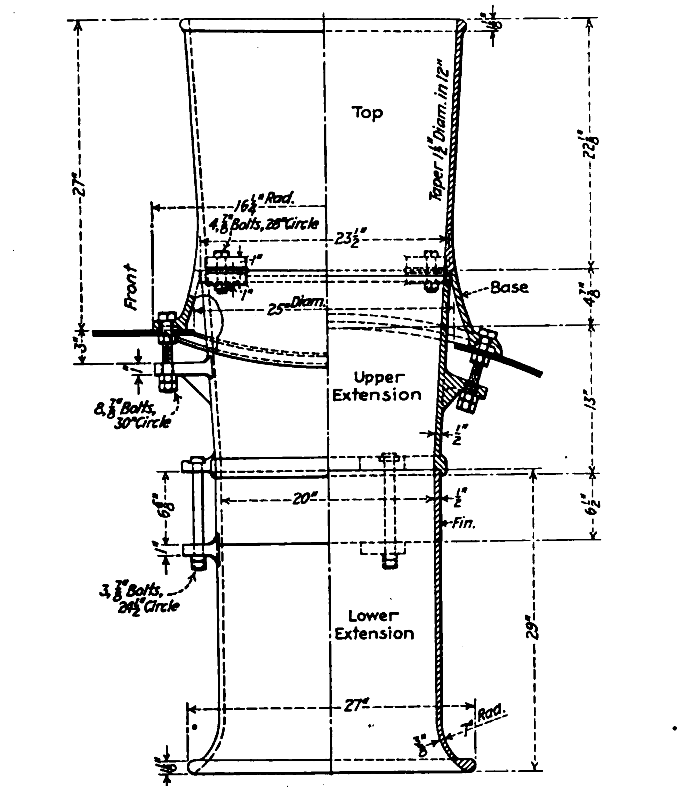


28-In. by 30-In. Cylinders for the Southern Pacific 4-8-2 Type Locomotive

The frames, as well as all other castings subjected to heavy stresses, are made of high grade cast steel, thus permitting considerable reduction in weight. The main frames are of the two-bar type, 6 in. wide, the depth of top rail over jaws being 7¼ in. for first and main drivers and 6¾ in. for third and fourth drivers. The frames at the cylinder fit are of the single-bar type of slab section, and provision was made for ample bolting and large keys. They are unusually well braced throughout. The driver brake cylinders are secured to the main frames just back of the steam cylinders and placed in a horizontal position, thus relieving the frames of unnecessary stresses due to braking. The rear section is a Commonwealth Steel Company's cradle casting, the front end of which is so designed that the trailing truck can be dropped down

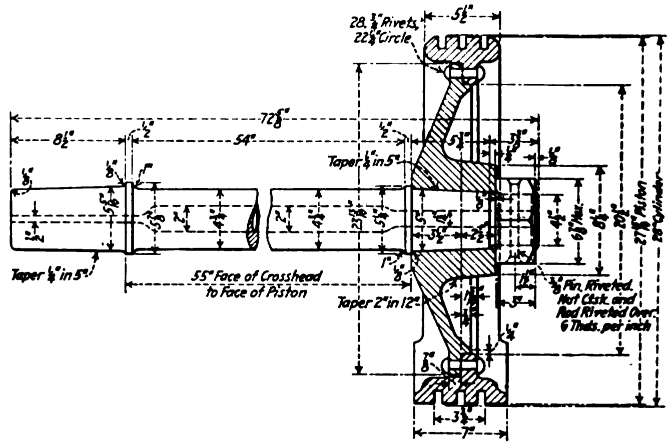
without moving the truck back. This facilitates making repairs to the booster.

The journal bearings throughout are unusually large, especially the main, which is 13 in. in diameter by 22 in. long. The frame brace crossties forming the extended



The Four Piece Stack Facilitates Renewals and Adjustments for Draft

pedestals for the main driving boxes are of high grade cast steel and, in addition to being well secured to the frame pedestals, are tied together, top and bottom, by supplementary pedestal binders, which add much to the rigidity of the equalizer provides a more stable construction by keeping the spring rigging lined up, particularly on 4-8-2 type locomotives. On lighter power this type of equalizer is not so essential and the advantage of its use has for some time been practically overlooked. The Southern Pacific has again brought this design into use by installing the bent equalizers on their 4-8-2 type locomotives, which will obviate the trouble

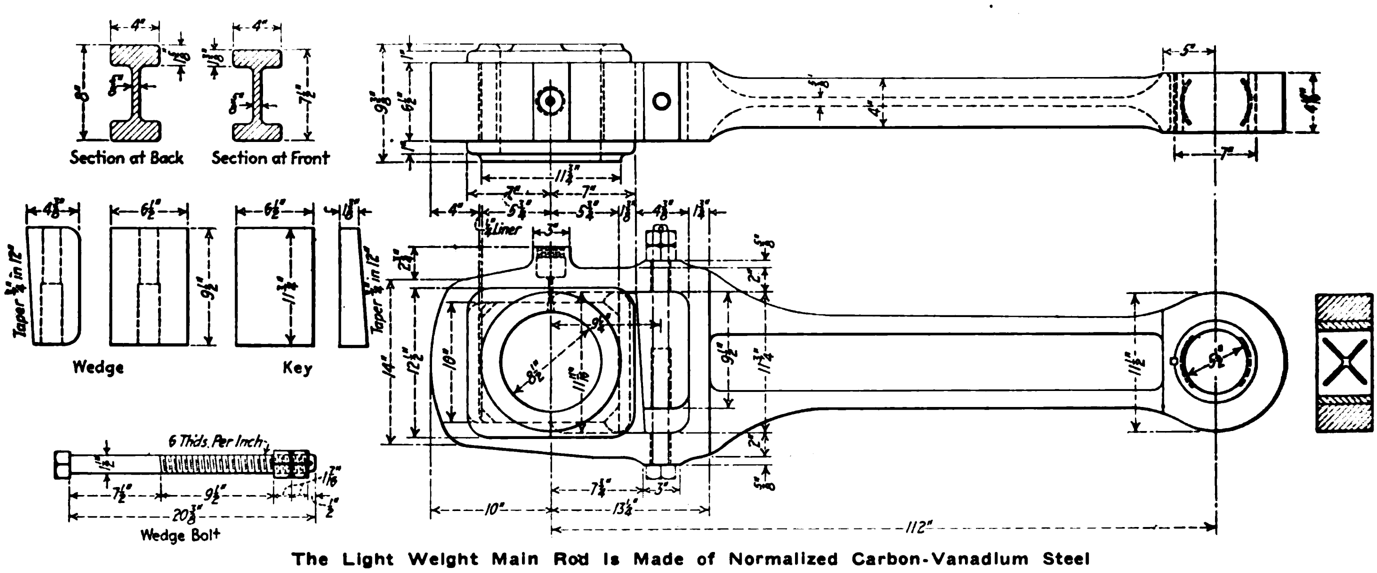


Hollow Piston Rod and Built-Up Z-Type Piston Reduce the Weight

ordinarily experienced with the spring rigging on this type of locomotive.

Careful Design Reduces Weights and Dynamic Augment

One of the outstanding features in the design of this locomotive is what has been accomplished in obtaining increased tractive force without increasing the stresses set up in the track and roadbed. To accomplish this, the engine is equipped with a constant-resistance centering device. Also, the forward pair of drivers is fitted with the Franklin lateral motion device, thus making ample provision for the engines to take curves with a minimum stress in the track. These centering devices also hold the engine steady on a tangent



The Light Weight Main Rod Is Made of Normalized Carbon-Vanadium Steel

pedestals and prevent journal bearings and axles from wearing conical.

It is interesting to note that the spring rigging has been constructed to incorporate bent equalizers similar to those used on the Southern Pacific 2-8-0 type locomotives, which were placed in service some 20 years ago. This is design of track, reducing to a minimum the lateral movement due to the steam action.

In order to keep down the dynamic augment to a minimum, the engine is equipped with connecting rods of normalized carbon-vanadium steel of I-section, hollow piston rods and Z-type pistons, thus providing light reciprocating parts, 50

per cent of which are balanced. The total weight of the reciprocating parts is 1,830 lb., or one pound to each 201 lb. of the total weight of the locomotive in working order as compared with the ratio of 1 to 160, which is generally considered good practice.

The following tabulation shows a comparison of the weights of the reciprocating and revolving parts for the 4-8-2 type locomotives with the weights of similar parts for the 2-8-2 and 4-6-0 types which the new locomotives displaced. This is interesting in that it shows that by refinement in design and the use of higher grade material a much more powerful and heavier locomotive has been built without increasing the disturbing forces in track.

WEIGHTS OF RECIPROCATING AND REVOLVING PARTS

	4-6-0	2-8-2	4-8-2
Cylinders, diameter and stroke....	23 in.x28 in.	26 in.x28 in.	28 in.x30 in.
Driving wheels, diameter..........	69 in.	63 in.	73 in.
Boiler pressure	210 lb.	200 lb.	210 lb.
Tractive force	38,320 lb.	51,080 lb.	67,660 lb.
Piston and rod complete..........	597 lb.	685 lb.	794 lb.
Crosshead and pin complete........	449 lb.	475 lb.	640 lb.
Total weight of main rod.........	861 lb.	1,006 lb.	1,217 lb.
Total weight of parallel rods......	966 lb.	1,371 lb.	1,253 lb.
Total weight of reciprocating parts.	1,518 lb.	1,691 lb.	1,830 lb.
Ratio, reciprocating parts to total weight of locomotive............	1/144	1/166	1/201

POUNDS WHEEL PRESSURE ON RAIL

4-6-0 Locomotive	1st	2nd	3rd	4th
Dynamic augment at 63 m. p. h.	10,425	12,025	11,170	......
Static wheel load	29,950	31,400	25,600	......
Total wheel pressure...........	40,375	43,425	36,770	......
2-8-2 Locomotive				
Dynamic augment at 63 m. p. h....	11,334	11,558	11,334	11,334
Static wheel load	25,650	26,200	27,000	26,000
Total wheel pressure	36,984	37,758	38,334	37,334
4-8-2 Locomotive				
Dynamic augment at 63 m. p. h. ...	8,075	8,435	8,110	8,110
Static wheel load	30,800	30,550	30,750	30,900
Total wheel pressure	38,875	39,985	38,860	39,010

Special materials were used in parts subjected to heavy stresses as follows:

QUENCHED AND TEMPERED STEEL

Tensile strength 85,000 lb. per sq. in.

Crank pins	Driving axles
Main crank pins, hollow bored	Engine truck axles
Piston rods, hollow bored	Trailing truck axles

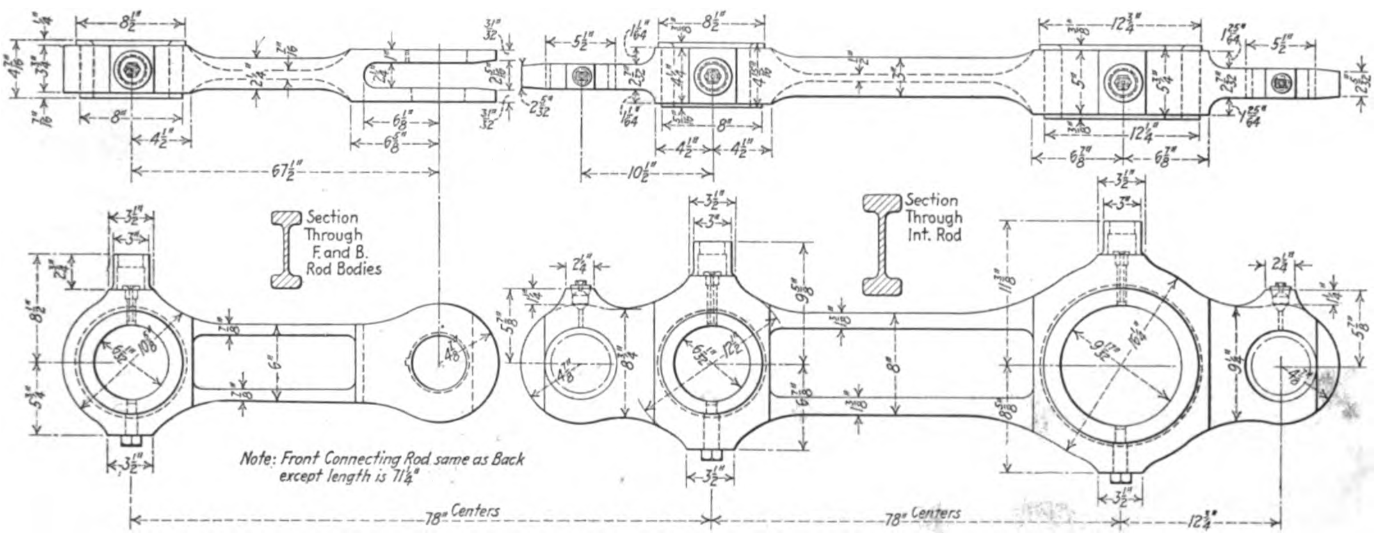
NORMALIZED CARBON-VANADIUM STEEL

Tensile strength 90,000 lb. per sq. in.
Main and side rods

SPECIAL GRADE CAST STEEL

Tensile strength 75,000 lb. per sq. in.

Main frames	Lateral motion driving box, spacer and rocker
Frame crossties	Engine truck swing frame, etc.
Frame filling castings	Driving spring stirrups
Driving and trailing wheel centers	Guide yokes
Driving and trailing boxes	Spring saddles
Pedestal caps	Reverse shaft bearings
Pistons	Link supports and checks
Cylinder heads	Bumper bracket
Back steam chest heads	Engine truck center plate
Crossheads	



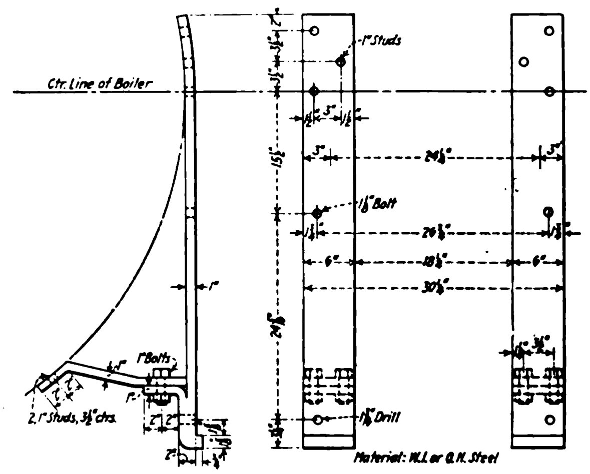
Normalized Carbon-Vanadium Steel of 90,000 lb. Tensile Strength Is Used for the Side Rods

Special Equipment and Details

The Westinghouse No. 6 ET brake equipment is applied, the air being supplied by one 8½-in. cross-compound compressor. The application of brakes to the trailing truck wheels brings the braking power of these locomotives up to the maximum, since this results in all the wheels of the locomotive being equipped with brakes. Clasp brakes are used on the tender truck wheels.

The supports for the air compressor and the feedwater heater are of wrought iron construction, and have been developed by the Southern Pacific to overcome the trouble experienced with the old design of cast steel supports working loose on the boiler. That for the air compressor is illustrated; that for the feedwater heater is of similar design.

A flange lubricator is applied, which provides lubrication for the flanges of the front driving wheels. The oil reservoir is located on the left side of the smokebox, where the crude oil used is sufficiently heated to run through piping leading to the front driving wheel flanges, the flow being regulated by needle valves. Flange oilers are also applied to the trailing wheels.



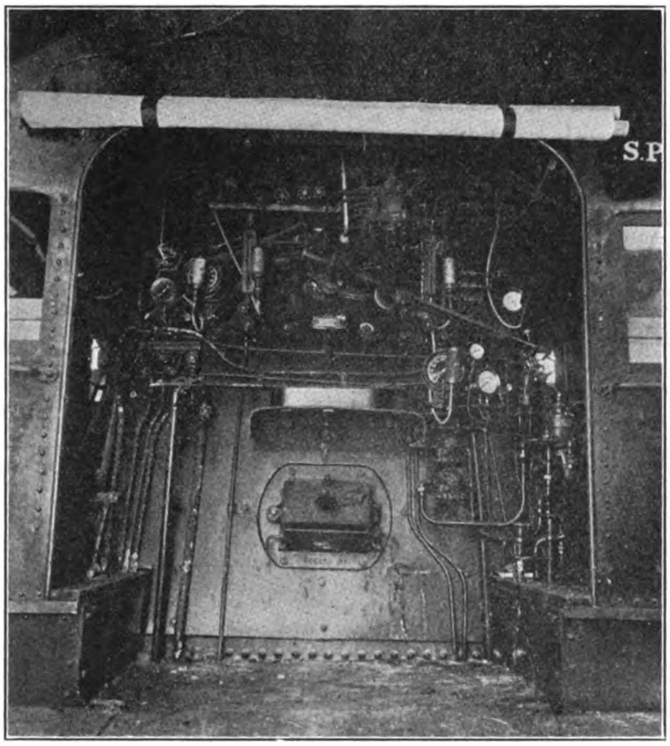
Light, Yet Rigid Forged Bracket for 8½-In. Cross Compound Air Compressor

The feedwater is supplied by one Worthington combined feedwater heater and a pump of 7,200 gal. capacity per hour, placed on the left side and by one Nathan non-lifting injector, placed on the right side, the latter being used only in cases of emergency and when the locomotive is not working.

Another source of reduction in weight without sacrificing

strength is in the application of a shorter and somewhat narrower cab. By placing the steam turret on the outside of the cab at front, it was possible to make a material reduction in the length of the cab. By eliminating the two doors at the front, which with large size boilers have, of necessity, always been made so narrow as to be very impractical, the width of cab has also been decreased. However, a window at the front on each side has been applied. The saving in weight on account of the application of the smaller cab amounts to about 200 lb. To take the place of cab doors, the steel floor of the cab has been extended 5 in. out beyond each side of the cab to be used as a running board and handholds have been conveniently located near the eaves to enable enginemen to pass around outside of the cab to and from the running boards at front. This extra width of cab floor dispenses with the use of supplementary running boards, located just below the cab floor, which is the practice on many roads for large power. A further saving of 300 lb. is thus effected. Moreover, for convenience of the engineman, the blow-off cocks are operated by means of two levers located in the cab, one on each side.

Special attention has been given to the arrangement of cab fixtures and operating levers, as the satisfactory and economical operation of powerful locomotives depends upon the convenient location of gages and controlling devices. Extension handles are applied to all valves on the top of the boiler head in inaccessible places, and arranged in convenient locations. They are supported by a wrought iron bracket secured to the roof of the cab, the bracket carrying an aluminum name plate having the name of each control handle stamped in ¾-in. letters. These letters are filled with black paint and the surface of the plate is polished.



The Cab Is Short, Compact and Well Arranged

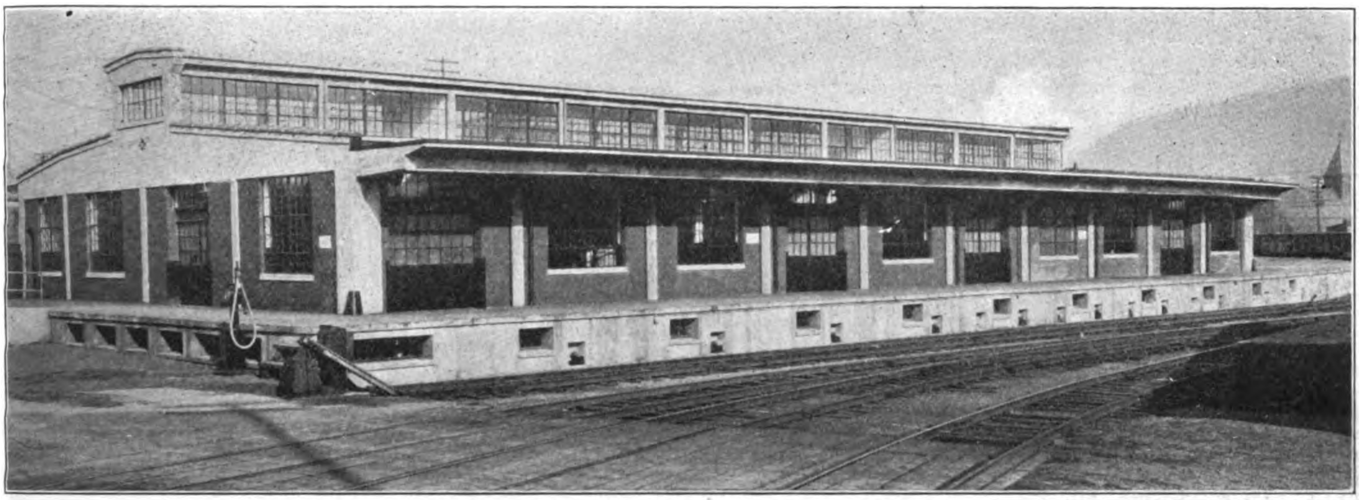
The tender is of the Vanderbilt type, carrying 4,000 gal. of oil and 12,000 gal. of water. The tank is carried on a Commonwealth cast steel frame, made in one piece with the bumpers and the transverse bolsters, which serve as tank supports. The four-wheel trucks are of the Commonwealth design, with cast steel frames and swing bolsters. This is an equalized pedestal type of truck, fitted with both helical and triple elliptic springs. Side bearings are used on the rear truck only.

The principal dimensions, weights and proportions of these locomotives are given in the accompanying table.

Railroad	Southern Pacific
Builder	American Loco. Co.
Type of locomotive	4-8-2
Service	Passenger
Cylinders, diameter and stroke	28 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1¼ in.
Exhaust clearance	1/16 in.
Lead in full gear, constant	¼ in.
Weights in working order:	
On drivers	246,000 lb.
On front truck	61,500 lb.
On trailing truck	60,500 lb.
Total engine	368,000 lb.
Tender	226,900 lb.
Wheel bases:	
Driving	20 ft. 0 in.
Rigid	13 ft. 0 in.
Total engine	42 ft. 3 in.
Total engine and tender	83 ft. 6 in.
Wheels, diameter outside tires:	
Driving	73 in.
Front truck	36 in.
Trailing truck	51 in.
Journals, diameter and length:	
Driving, main	13 in. by 22 in.
Driving, others	11 in. by 13 in.
Front truck	7 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	210 lb.
Fuel, kind	Oil
Diameter, first ring, inside	82 7/16 in.
Firebox, length and width	121 1/16 in. by 90 in.
Height mud ring to crown sheet, back	65½ in.
Height mud ring to crown sheet, front	90½ in.
Combustion chamber length	75 in.
Tubes, number and diameter	223—2¼ in.
Flues, number and diameter	45—5½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	75.7 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	350 sq. ft.
Tubes	2,813 sq. ft.
Flues	1,388 sq. ft.
Total evaporative	4,551 sq. ft.
Superheating	1,162 sq. ft.
Comb. evaporative and superheating	5,713 sq. ft.
Tender:	
Style	Vanderbilt
Water capacity	12,000 gal.
Fuel oil capacity	4,000 gal.
Trucks	4-wheel
General data estimated:	
Rated tractive force, 85 per cent	57,510 lb.
Rated tractive force with Booster	67,660 lb.
Cylinder horsepower (Cole)	2,965
Boiler horsepower (Cole) (est.)	3,067
Speed at 1,000 ft. piston speed	43.4 m.p.h.
Steam required per hour	61,672 lb.
Boiler evaporative capacity per hour	57,014 lb.
Feed water heater, equiv. evap. capacity per hr.	6,784 lb.
Total evap. capacity per hr.	63,798 lb.
Weight proportions:	
Weight on drivers ÷ total weight, per cent	66.8
Weight on drivers ÷ tractive force	4.28
Total weight engine ÷ cylinder hp	124.0
Total weight engine ÷ boiler hp	120.0
Total weight engine ÷ comb. heat. surface	64.4
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	103.4
Comb. heat surface ÷ cylinder hp	1.93
Tractive force ÷ comb. heat. surface	10.07
Tractive force × dia. drivers ÷ comb. heat. surface	736
Cylinder hp. ÷ grate area	39.2
Firebox heat. surface ÷ grate area	4.63
Firebox hea. surface, per cent of evap. heat. surface	7.69
Superheat. surface, per cent of evap. heat. surface	25.53

A "Life Table" recently prepared by the statistical division of the Metropolitan Life Insurance Company from figures compiled by the Locomotive Engineers' Mutual Life and Accident Insurance Association, shows that the average locomotive engineer of 28 may count on living until he reaches the age of 69. Despite the hazards of the engineer's calling, insurance figures show a substantial decline in mortality among men in that occupation during the past 10 years. Between the ages of 31 and 55, the declines ranged from 32 to 44 per cent. Beyond the age of 55, the figures varied, but this reflected the small number exposed to risk.

A decline in the accident death rate from 318 per 100,000 in 1912, to 167 per 100,000 in 1922, shows the great improvement in safety provisions for the operating personnel of American railroads and accounts for a large part of the saving in mortality at the age range from 31 to 55 years.



The New Reading Company Oil House at Reading, Pa. The Storage Tank Filling Connections Are Shown in Recesses Under the Platform

The Reading Builds Model Oil Storehouse

Fireproof Structure, Well Lighted and Ventilated, Completely Equipped with Modern Facilities

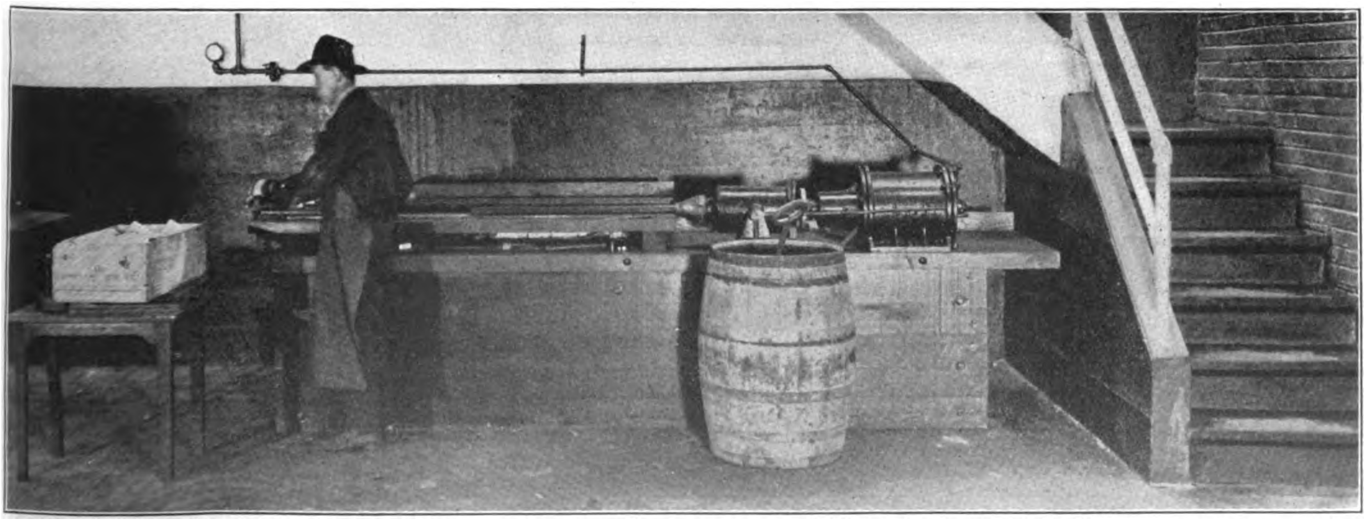
ONE of the most modern and completely equipped oil storehouses in America has just been completed and put in operation by the Reading Company at Reading, Pa. The building is constructed of reinforced concrete, steel and brick, making it entirely fireproof. It is 75 ft. wide by 150 ft. long and contains one story and a basement. A platform 3 ft. 9 in. above the top of the rail with a total area of 6,624 sq ft., adjoins the building on one side and the two ends. On the west end and south side of the building it is 10 ft. wide. At the rear, or east end, it is triangular in shape, tapering from a width of 80 ft. at the building to 16 ft. wide at the extreme end, 138 ft. from the building. This end platform is used for storing empty barrels and is laid out with 2-in. painted lines, into spaces which are stenciled to designate the kinds of barrels to be placed in them. A ramp leads from the ground on the west end of the building to the platform, for the use of electric trucks.

The loading and unloading track on the south side of the building will hold seven cars. The storage tank filling connections are located in recesses under the platform.

The basement extends out beneath the front and west end platforms and is 85 ft. wide by 160 ft. long. A room along the south side, adjoining the unloading track, 40 ft. wide by 155 ft. long and 13 ft. high in the clear, accommodates 12 large rectangular tanks with a capacity of from 10,000 gallons to 16,000 gallons each. A 10-hp. motor is provided to operate an agitator. An open duct and drain, 5 ft. wide by 2 ft. 6 in. deep, runs the full length of the building just back of the tanks. In addition to providing for drainage and pipe lines, it is also equipped with a narrow gage track on which is operated a steel car with a tank, which may be placed opposite any of the tanks when cleaning them out. Concrete pillars, 12 in. above the level of the floor, provide sufficient place under the tanks for steam radiators and pipe lines. The oil from cars runs into storage tanks by gravity.

The north half of the basement has a clear height of 9 ft. and is divided into five rooms. The east room, containing 24 tanks ranging in capacity from 120 gallons up to 1,500 gallons, is 41 ft. by 43 ft. Four agitators operated by a 5-hp. motor are provided on four of the tanks. An oil filter is also located in this room.

Adjoining this room on the west is a barrel room, 34 ft.



One Room in the Basement Is Used for Molding and Storing Rod Cup Grease

The Barrel Storage Room—Light and Ventilation Are Provided by the Clerestory

by 73 ft. with entrance from the main floor above by stairway and electric elevator. The elevator has a capacity of 4,000 lb. and is used in hoisting the barrels to and from the main floor. A small space, 15 ft. square, in this room is provided with a compounding tank 4 ft. 6 in. wide by 8 ft. long by 3 ft. deep, for use in manufacturing soft soap, disinfectant and car cleanser.

The room next adjoining measures 14 ft. by 34 ft. and is used for cleaning and storing cans. The room at the west end of the basement is 23 ft. wide by 34 ft. long. Here rod cup grease is molded and stored for use. A stairway leading from this room to the platform on the outside of the building has been provided in order to avoid going through to the other end of the building to reach the first floor from this room.

On the east end of the main floor, adjoining the barrel storage platform, a room 43 ft. wide by 74 ft. long, contains 24 hand pumps of five gallons capacity each, with two extra or emergency hand pumps of the same capacity; five power pumps, each with a capacity of 40 gallons per minute, and one extra or emergency power pump; one 6,000-lb. capacity scale for general use, and one 12,000 lb. capacity scale under the compounding oil tank, which is 6 ft. 1 in. wide by 7 ft. 7 in. long and 3 ft. 9 in. deep. This room also contains four journal packing tanks 8 ft. 4 in. by 8 ft. 4 in. by 2 ft. 9 in. deep, three of which are used for freight car and one for coach packing. Outside of this room under the concrete platform are located two circular tanks of 10,500 gallons capacity, each, both containing engine gasoline, and one of 500 gallons capacity with 88 deg. gasoline.

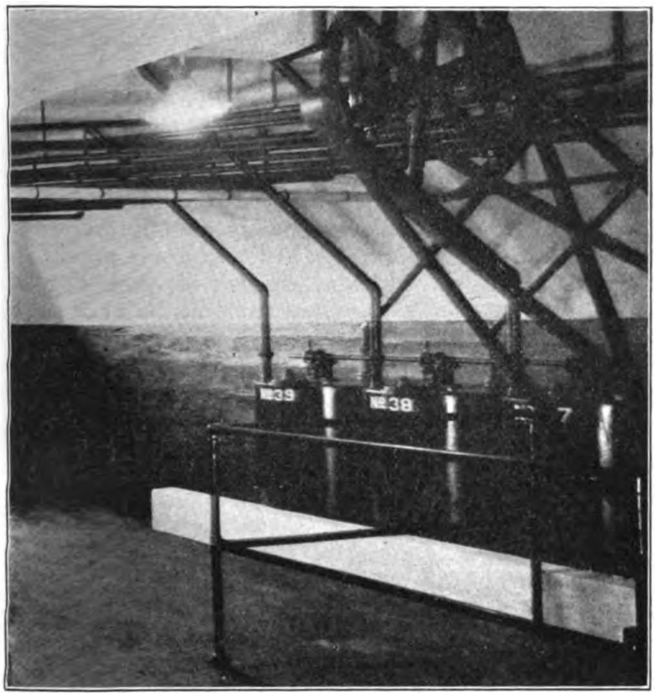
The center room, used for barrel storage, is 72 ft. wide by 73 ft. long, with a 12-ft. by 12-ft. space for toilets and wash bowls. This room also contains the 10-ft. by 10-ft. enclosed electric elevator shaft. The floor of this room is marked off with two-inch white lines, with proper stenciling, into spaces reserved for the various classes and grades of oil that are stored in barrels.

A 28-ft. by 66-ft. room at the west end of the building is separated by a fire wall from the adjoining barrel room. This is used for the storage of waste.

The Pump Room at the East End of the Building; Journal Box Packing Tanks at the Left

Along the driveway at the west end of the building, a 500-gallon gasoline tank with an outside pump is provided for the use of the company's motor trucks.

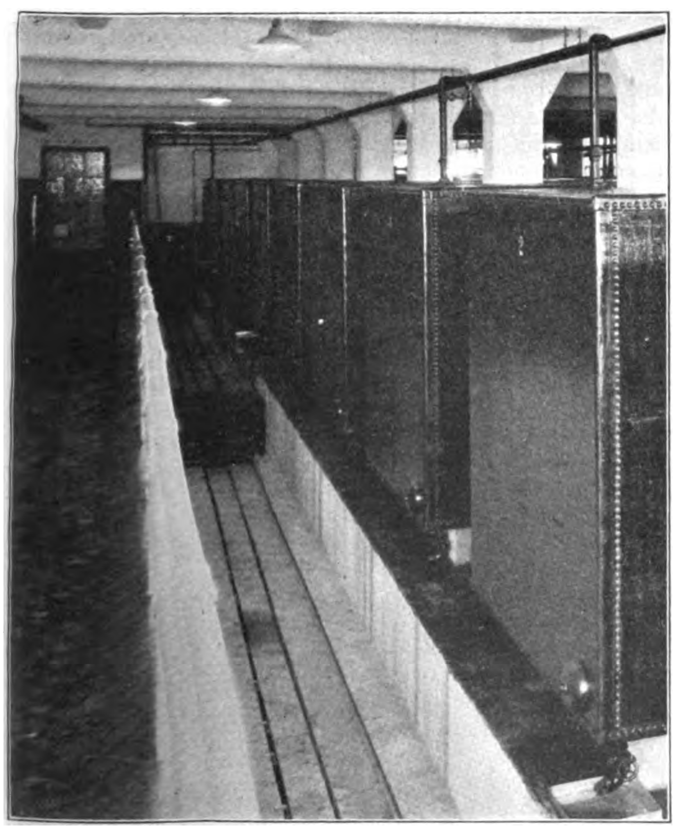
A commodious skylight extends the full length of the building, providing ample light and ventilation. The build-



Motor-Driven Agitators Are Provided in Four Tanks

ing is equipped throughout with electric lights and with steam, water and air lines, all of which are painted in distinguishing colors.

It is anticipated that, with this modern building and its



The Storage Tanks Are Located in the Basement

facilities, the stores department will eliminate leakage and tank waste and at the same time insure to users good clean oil with a maximum service at a minimum cost. It will also facilitate the release of tank cars more promptly. A tank car of heavy oil can be unloaded in a few hours and a tank car of kerosene in less than an hour, enabling the oils to be unloaded in the morning, a shift made and the cars placed for shipment before noon. In filling or drawing there is no

All oil tanks	Black
All oil pumps (including power pumps)	Olive green enamel
All oil filling lines and drip return lines	Black
All oil tank vent lines	Black
All oil suction lines	Red
All oil pump delivery lines in basement and pump room	White
Outside gasoline pump	Red enamel
Compressed air lines	Bright green
Water lines	Yellow
Steam radiators and piping	Navy gray

waste of oil, the drip from the pumps going back into the tanks. The filling of barrels is accomplished rapidly, with an exact check on the amount required and shipped. This will assist in avoiding differences in the oil accounts.

Plans for the building were drawn and the construction carried out under the supervision of S. T. Wagner, chief engineer of the Reading Company. The equipment layout and installation of steam, water and air lines was under the direction of C. A. Bingaman, mechanical engineer. The contractor was Robert E. Lamp & Company, Philadelphia, Pa. The equipment, consisting of the tanks, pumps, etc., was furnished and installed by the Tokheim Oil Tank & Pump Company, Fort Wayne, Ind.

The Superheater—Its Abuse as a Fuel Saver*

By Bard Browne

Service Engineer, The Superheater Company

With over 40,000 superheated steam locomotives operating in this country alone, it is not necessary for me to impress you with the superheater's importance as a locomotive appliance. Each one of you was once sold on the idea of the superheater, either by the Superheater Company or by one of your colleagues and many of you induced your companies to spend the necessary money for superheater applications. All of you, I dare say, carry, safely tucked away in your consciousness the conviction that, since you ordered a properly proportioned superheater and applied it to your locomotive in accordance with our advice, you are obtaining an average fuel saving of 25 per cent and an average water saving of 35 per cent. In the rush of your affairs you feel secure as to the superheater as a fuel saver.

On the other hand, we who make a continual study of the subject see, from time to time, evidence of tendencies to take too many things for granted, of an inclination to sit back and let the superheater live up to its reputation.

Superheated steam is over-heated saturated steam. If we put additional heat, or what is the same, additional energy into a pound of saturated steam, we can naturally get more out of it when this steam does expansive work. The more additional heat we put in, *i.e.*, the more we superheat the saturated steam, the more additional work we can gain. That part is quite comparable with putting more or less energy into the steam by generating it with more or less pressure. The important point is that to think of superheated steam without a statement of the amount of superheat, is just as indefinite as to think of saturated steam without a statement of its pressure.

The steam enters the superheater always at the tempera-

*Abstract of a paper presented at the convention of the International Railway Fuel Association, at Cleveland, Ohio, May 21-24, 1923.

ture corresponding to boiler pressure, but the temperature of the heating gases, and therefore the temperature difference between the gases and the steam, depends upon a good many factors. It is principally this difference in temperature between gas and steam which determines the capacity of the superheater, or the amount by which the steam can be overheated. We must keep in mind that the superheater capacity, after the size and number of units has once been fixed, cannot be adjusted at will, but is entirely determined by boiler and grate performance. It is entirely dependent on the fixed amount of unit length and upon the fixed location of the superheater tubes with relation to the flues; in other words, upon the amount and disposition of the superheater heating surface, and, furthermore, upon the condition of the steam within the superheater and the gases outside the superheater. The steam and gas conditions can be precalculated for normal boiler performance, but naturally not for departures from normal.

In previous papers and reports submitted to this association, we have been sufficiently cautioned against abnormal boiler and grate performance as endangering superheater capacity. Thus the question of carrying an undue amount of water over into the superheater tubes, which water must be evaporated and thus absorbs heat lost for superheating, has been agitated. Other conditions affecting superheater capacity, such as coated or stopped-up flues and tubes, imperfect combustion and low firebox temperatures on account of incorrect firing, have been amply discussed.

One phase of the subject which has, however, not been sufficiently emphasized in the past, is interference of superheater capacity by improper or negligent superheater maintenance. Superheater unit tubes naturally see very hard service, harder than is commonly appreciated. Partially or highly superheated steam is a very poor conductor of heat, and therefore the metal of the tube in contact with such steam is at a very much higher temperature than the metal of the boiler tubes, which is cooled by water. Then, further, the steam and metal temperatures constantly fluctuate in the working of the engine, whereas the metal of the boiler tubes does not change its temperature so much, because the water is always at the same temperature as long as the pressure does not fluctuate unduly. These changes in metal temperature in the superheater cause differential expansion strains, which again lead to crystallization and ultimate failure, mostly at the points where the greatest mechanical strain occurs, directly under the ball joint, and where the greatest heat strain occurs, at the back return bends.

When the railroads began to patronize our reclaiming department, where we re-condition failed units, and sent to us carloads of units, we had quite a revelation. We saw to what an extent it had been necessary to make emergency repairs to units, evidently in order to keep from tying up engines in the face of an insufficient stock of spare units, and that many of the emergency repairs seriously interfered with the capacity of the superheater. Many units were unduly shortened, probably because the metal of the tube was burned over quite a distance from the back return bend. Many had been repaired by autogenous welding with such a plentiful use of welding metal that either internal free area for the steam flow, or the external area for the flow of gases was appreciably restricted. Some units had the original back return bends removed and home-made structures of the crudest design and strength substituted, with the most appalling restrictions.

It is quite evident that whoever made or authorized these emergency repairs did not realize how finely the length, location and cross-section of super-heater units and flues were calculated by the designer, and how much departure from the original design affects superheater capacity and fuel saving. Units must be maintained of about the length fixed by the original design. In reclaiming units we do not allow more than six inches reduction of original length. The internal steam area through the unit pipe must not be obstructed by injudicious bending or improperly made butt-welds, because the resultant pressure drop means loss of capacity, longer cut-offs for a certain power output, and lower cylinder efficiencies, with a corresponding reduction in the available fuel economy.

Net gas areas around the units must be maintained as originally calculated, because we are working in the combination of superheater and boiler, with a definite draft balance between the superheater flues and small tubes; the maintenance of that balance is imperative for the maintenance of the superheater performances originally contemplated. The introduction of forged return bends in place of cast steel return bends is not only an improvement in mechanical jointing, but the forged return bends present less obstruction to the gases flowing through the flues than did the cast steel return bends. Obstruction at the back end of the flue, where the gases have a high velocity due to their high specific volume, is serious.

You may say that an occasional unit improperly repaired will not upset the superheater performance appreciably. Probably not, but if you let the bars down, where is the improper practice going to stop? I urge, then, that you do not consider or allow those associated with you to consider the superheater as a bundle of pipes placed in the boiler at random, but a carefully proportioned heat exchanger which must be properly maintained if it is not to lose capacity, or your companies to lose a part of the fuel saving which you originally obtained.

Safety as a Builder of Morale*

By F. W. Mitchell

Director of Personnel, New York, New Haven & Hartford

No mechanism that functions in the production of transportation is as complex in its makeup as are the human beings to whom its operations are committed. And although the human element is susceptible to great changes, by means of education and training, it can hardly be argued that the same effort has been given to railroad "humanics" that has gone into the development of the mechanical resources. It would be difficult to describe just how we should proceed, in order to attempt in this field the accomplishment that is apparent in the mechanical. Some things, however, are evident, and among these we find first that there should be greater care used in selecting our human material, investigating the references presented and the conditions which surrounded the new employee before taking him into the organization.

For a number of years the railroads have been carrying on safety work. The benefits derived from this effort have been far in excess of the cost of the work. It is not too much to say that the entrance into the larger field, and the expanding activities which are directed toward the development of morale have resulted in a measure from the evident effects of the safety work in this direction.

There was unquestionably a time in the history of our American railroads when the voice of the public was calling loudly for speed in annihilating distance together with reliability in maintaining schedules. The effect of this strong sentiment was to increase, in no small degree, not only the number of "chance takers" in train operation, but also the extent of the risks that they were willing to take. Operating officers noted their violations of rules and instructions when conspicuous consequences compelled recognition. Investigations of accidents revealed such information only as it was

*From an address at the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4, 1923.

impossible to conceal. A spirit of competition and rivalry tended to further aggravate the dangerous situation. Cautionary measures were set aside by the employee if so he might thereby execute some stunt which, if successful, might mark his exceptional ability. There was a wide separation in the theory and practice of safe operation. Confidence was weakened; morale reduced. That which should have been an army of organized workers for safety was becoming a mob of "go as you please as long as you're lucky" buccaneers.

Even the grounds for promotion were becoming more and more based upon the element of "luck," and the "good guesser" could ride the top wave of popularity. Safety was becoming an artificial veneer.

When Morale Appears

But there was a penalty to all this and from time to time it presented stern demands. It became evident that something was going very wrong and that a change was required not only in methods but in the appraisal of values. Safety first was made the slogan for the railroad workers. Committees were appointed. Meetings were held. Conditions were revealed which needed correction. The mirror was held up before dangerous practices that showed them in their true aspect. Officers and men were brought into close personal contact in the pursuit of safety. Together they searched for the remedies for situations which their new relationship was compelling them to face, and together they began to realize that their interest was common in endeavoring to find an answer that would satisfy the conscience of each that the requirements of safety were being met.

When the enlightened conscience is satisfied with the contacts with life, as it is expressed in action as well as in word, that elusive and almost indefinable element which we call morale, appears; because an atmosphere which is conducive to its growth and development has been found. There is something in every real man that calls him to put his best effort into his work. He may vary somewhat in his response to this call, but the knowledge that he is working together with other individuals in the army of employees to carry out a program for protection, is a compelling force; because it is founded in sincere endeavor, and carried out in the spirit of service. Its outgrowth is quickened morale. The whole trend of the safety work is toward the promotion of those forces, sentiments and actions which inspire respect, loyalty, and efficient service. The work furnishes a point of contact between employer and employee that is mutually advantageous. From the experience there comes the knowledge that other points of contact are available, and the means of securing them follow closely.

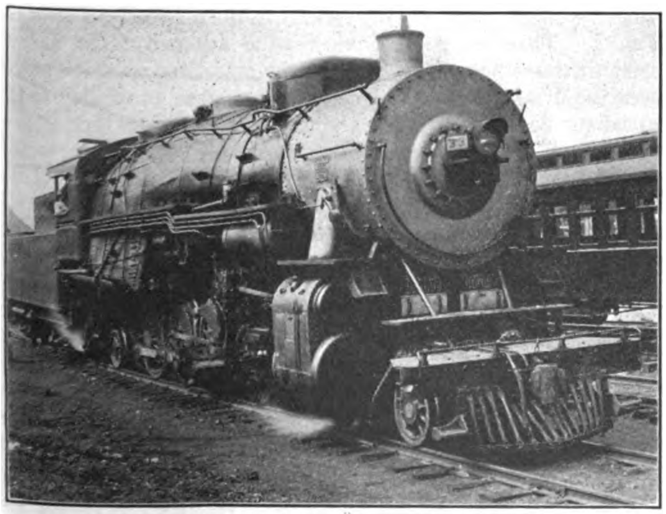
The principles on which safety work is founded, the sentiments which it fosters and the methods by which it develops have done more to build up morale upon the railroads than any other single agency. It has made for itself a place by providing an avenue for the expression of opinion, as well as the compulsion of safe practices, which entitles it to all the aid that can be extended, to the end that the work which it has begun in building up morale may be continued, sustained and enlarged by whatever additional means there may be provided to accomplish so important a task.

Force Feed Lubrication on Locomotives

An Original Method by Which Oil Is Automatically Supplied to the Various Bearing Surfaces

By A. H. Woodward
Chairman, Woodward Iron Company, Woodward, Ala.

SOME months ago the writer had an opportunity to ride on the engine of a local passenger train. There had been no oil or supplies put on the engine previous to leaving the terminal, but these were procured a little later at the roundhouse, two miles further along the line. The engineer did not oil around the engine as soon as the supplies were received at the roundhouse, but proceeded to the next station, which was 10 miles away, instead. Upon arriving at this point, the engineer oiled around while awaiting the unloading and loading of passengers and baggage. The running time between the two points was about 40 miles an hour. This engine had been run nearly 15 miles without any lubrication, after it had been standing approximately 16 hours.



Woodward Iron Company's Engine No. 30 Equipped for Forced Feed Lubrication

Of course, there is nothing new or remarkable about this procedure, nevertheless, the wear on the bearings alone would be enough to show that there was no economy in such a practice. The quantity of oil saved would be a very small amount in comparison to the cost of installing new bearings, so as a result of this experience, the writer went into the question of automatic lubrication for the locomotives of the Woodward Iron Company. After some investigation, one of the Santa Fe type locomotives of this company was equipped with three force feed pumps, one to oil the front truck and trailer, a second to oil all the driving wheel hub plates, guides, valve stems and pistons, rods, valve gear and shoes and wedges, and a third to oil the stoker.

Equipment

The pumps were supplied by the Lubricating Equipment Company, Birmingham, Ala., and are what is known as the "Forcit" type lubricator. Of the three pumps, two had a

capacity of five gallons and were equipped with 22 feed pipes; the third had a capacity of three gallons and provision was made for 12 feed lines. All of the pumps were provided with check valves.

The Alemite lubrication system was applied on the front and back ends of the eccentric blades, bottom and top link lifter, the trunion bushings, tumbling shaft boxes, the front and back ends of the union link, the front end of the radius rod, the top end of the combination lever, and on all the

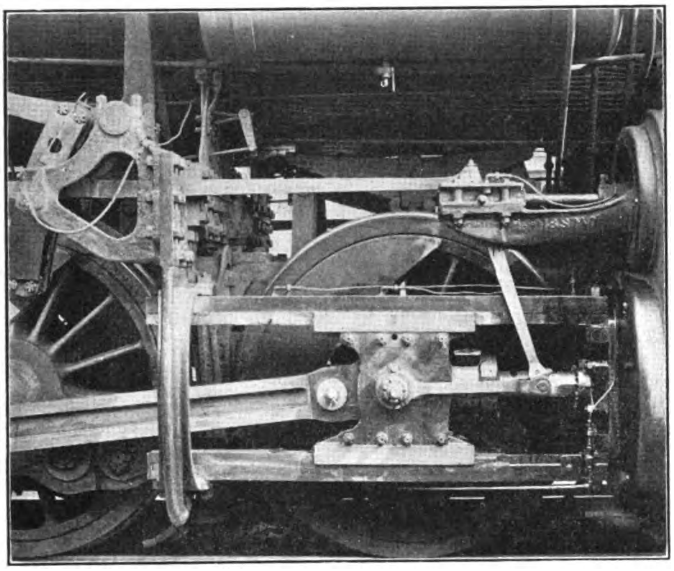


Fig. 1—Application of Feed Pipes to Valve Motion and Guides

knuckle pins and bushings. Practically every other bearing on the engine was fitted up for the use of an Alemite grease gun. The cylinders and valves were taken care of in the old way, with a steam lubricator.

Method of Installation

As partly shown in Fig. 1, the motion by which the pumps are operated, is taken from the valve gear on the right

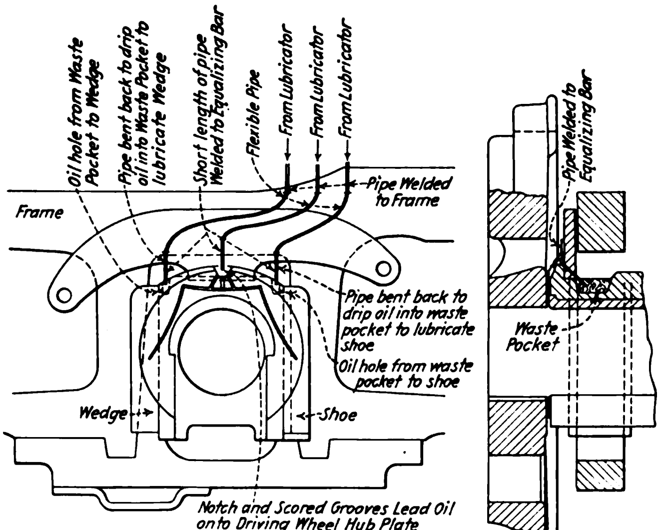
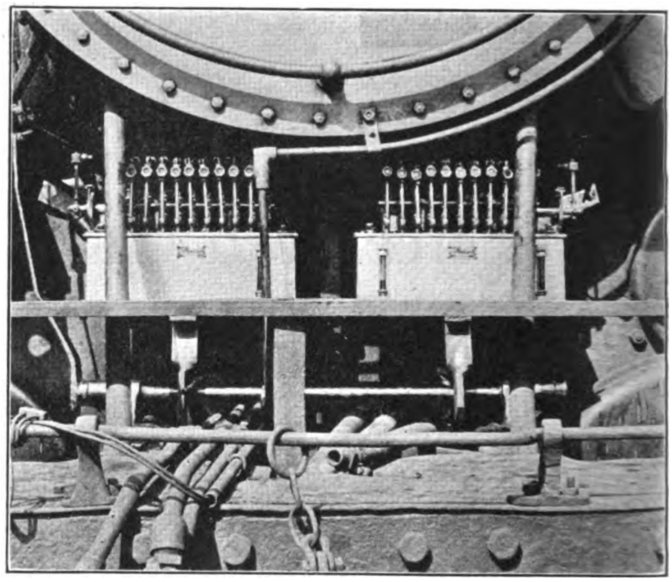


Fig. 2—Method Used for Lubricating the Shoes and Wedges

side of the engine by a connecting rod that extends to a crank arm placed under the smokebox. This crank arm is long enough so that it can operate both the pumps at the front end. Flexible pipe, fastened to the engine by means of clamps, is used to convey the oil to the various points of delivery about the engine. The force feed lubrication was applied to both sides of the engine at the following bearing surfaces:

Back driving box hub.
Main shoe and wedges.
Back intermediate shoe and wedges.
Front intermediate driving box hub.
Front shoe and wedge.
Front driving box hub.
Engine truck box.
Engine truck box hub.
Trailer truck box.
Trailer truck box hub.
Back shoe and wedge.
Front intermediate shoe and wedge.
Back intermediate driving box hub.
Main driving box hub.
Link block.
Valve stem.
Piston rod.
Back top guide.
Front top guide.
Bottom guide.
Outside valve stem guide.
Inside valve stem guide.

The method of application of the feed pipes at the valve gear and top and bottom guides, is also shown in Fig. 1. The arrangement of the delivery pipes for lubricating the



Two Lubricators Having a Capacity of Five Gallons Each Are Placed Under the Smoke Box

shoes, wedges and driving wheel hub plates is shown in Fig. 2. Three lines of flexible pipe are run from the lubricator to connections welded to the equalizer at three points over the driving box. The center connection is welded to the equalizer bar, as shown in the drawing, and passage is provided for the oil to feed into a waste pocket. Notches and scored grooves lead from the waste pocket to the face of the driving wheel hub plate. For the two outside connections, the pipe is bent back in order to drip oil into a waste pocket from which oil is fed the shoe and wedge.

The oil reservoirs on the force feed pumps carry a 10-days' supply of oil for this particular class of engines, which are operating on a 12-hour mine run. These engines now use about as much lubricating oil as when they were oiled by the engineer. The advantage gained by this system is that the oil is received automatically and regularly by all the bearing surfaces. After a four-months' trial, it appears that the life of the various bearings is going to be increased very materially. When the apparatus was first installed, the enginemen were inclined to look upon it with disfavor, but at the present time they seem to be much pleased with it.

Helpful Suggestions from Canadian Apprentice

Pleads for a Thorough Training Which Will Fit the Ambitious Boy as an All-Around Capable Mechanic

By F. O. Robinson*

Machinist Apprentice, Canadian National Railways, Fort Rouge Shops, Winnipeg, Man.

THE modern apprentice, if he is to make headway at his trade, must have a great deal more than practical experience. The time when that was sufficient is passed; the machinery of today is so highly developed and complicated that in order to make a first-class mechanic an apprentice must have considerable theoretical knowledge of mechanics, as well as a good general education. No mechanic today could possibly thoroughly understand all the different machine constructions, but it is essential that we have a good general knowledge of machinery, both theoretical and practical; and that in my opinion is what the apprentice should receive, as well as such lectures on moral and business subjects as will tend to increase his value to his company and country. Therefore, when a young man starts work with a company to learn a trade, he should be given as good an education under as competent paid instructors as it lies in the company's power to provide. Although I fully realize that the apprentice has been given opportunities to learn, and care has been taken to aid him in a number of ways, I believe there is still room for a great deal of improvement.

F. O. Robinson

The aim of the apprentice should be to become so well acquainted with the principles of mechanism that he will not only understand a certain number of machines, but from his knowledge of mechanical principles will be able to grasp the construction, design and operation of any unfamiliar piece of machinery that may be placed before him. In my opinion, the boy who is really interested in the trade he is learning should feel proud of his achievements and should stand ready to grasp and make good use of any opportunities that the company may offer to help to make him not only a good mechanic, but a resourceful, energetic and valuable workman in many other respects.

I do not think it will be out of the way here to outline a system which, in my opinion, would meet the needs of the modern apprentice. Of course, being a machinist apprentice in a locomotive shop, I shall write from that viewpoint.

Some Constructive Suggestions

When application is made by a lad who wishes to become a machinist apprentice, he should be taken in hand by the apprentice supervisor who should see that he is given an examination to determine as nearly as possible his mental power, character, alertness and education. The applicant should also be given a physical examination. If he passes both, he should be put to work in the shops for a probationary period of six months to determine whether he is really fitted to become a mechanic and is an energetic, conscientious worker. If he does not seem to be, it should be explained to him and he should be let go; in this way the misfits will be weeded out, the backward ones assisted and a higher standard established.

The apprentice supervisor should look after the welfare of the boys in general and oversee the work of the shop and school instructors. The shop instructor should be a man who is not only a good all-around mechanic, but can explain the theory related to each machine or job upon which the apprentices work. Each apprentice should receive thorough instruction on his machine its—construction, operation, repair and care. The shop instructor is too apt to become a kind of overseer of the conduct of the apprentice and shop instruction in its true sense may be forgotten.

There should be a regular schedule of shop work, a specified time on each machine, bench and floor job, and the apprentice should be given an examination on each machine before he leaves it. There is need of more instruction being given right in the shop where the machine is in front of the apprentice; the shop instructor should also give instructions in the shop on the use of hammer and chisel, shop scale, center punch, scriber, dividers, calipers, vernier calipers, micrometers, taps, etc., and the handling of all classes of wrenches and spanners, the level, plumb bob and surface gage; classification and use of files, scrapers and hack saws, rose bitting, reaming and countersinking. The working of each machine should be explained, as well as the tools used on it, and the best methods of setting up the work. Instructions should also be given on laying out on the marking off table. All this careful and thorough instruction is absolutely necessary if the apprentice is going to develop into an all-around, competent mechanic, and only men who can give it should be chosen as shop instructors. Care should be taken to place the apprentice with such workmen as will influence him in the right direction.

There should be a school of some kind at the shops and arrangements made for the apprentices to receive regular in-

*One of the papers which was awarded honorable mention in the competition for regular apprentices. The prize winning papers will be found in the January and February issues.

struction. Any good mechanic should not be eligible to the position of school instructor if the apprentice is to receive thorough and proper instruction. He should, if possible, have a teacher's certificate, or if he has not should possess a great deal of the ability of the professional teacher, as well as a good general knowledge of the science of mechanism. The apprentice should be allowed as long a time at school as the company can possibly spare, because it is there that he receives the true foundation for his shop work; without this school training he cannot hope fully to grasp the shop instruction and work.

School instruction should cover simple arithmetic, including reviews in addition, subtraction, multiplication, division, fractions, decimals, etc.; drawing, geometrical and mechanical; shop mathematics, including algebra, geometry, plane trigonometry; physics as it concerns simple machines, power transmission, horsepower, strength of materials and machine design. It should also include general studies, such as the hardening, tempering and selection of steel, classification of metals, care of machine tools, and some text book study. The school instructor should also give practical and theoretical detailed lectures on valve setting, air brakes, stokers, lubricators, injectors, boosters, feedwater heaters, etc., the locomotive in general and all its appliances. In my opinion, only a small portion of the time at school should be spent on text book study, as this is work which the apprentice can do at home, if he will, and I see no reason why one apprentice who will not study at home should be allowed to hold back those who are willing to. A regular system of study should be provided at the shop school and the classes arranged according to the ability and progress of the pupils, so that the backward ones will not hamper the others.

Special Lectures and Instructions

If possible, special lectures and instructions might be given to apprentices willing to attend outside of shop hours without pay. It would also be a great advantage if a small building or car could be equipped with machinery suitable for giving practical detailed instructions on the locomotive and its appliances, their construction and repair; the principle of the different machines, their construction and operation, etc.; and such practical work as could not very well be given in the school.

Moral and educational lectures could be given in this building by college professors and business men, which would all tend to keep up the apprentices' interest. A small library of good mechanical books and magazines might also be found useful in connection with this department, where the apprentice can spend his spare time in the evenings if he wishes. An educational club could be formed among the boys and debates on mechanical subjects arranged; competitions could be held and suitable prizes awarded the winners, such as tools, etc. Apprentices at outside points could compete by mail when possible, thus keeping all the apprentices in touch with each other. Talks by the company's officials and foremen all help to encourage the boys. It might help also if the apprentices' parents were kept posted on their progress.

It is absolutely essential in railroad work that the mechanic be an all-around man. To make the apprentice an all-around mechanic, four years is not sufficient and five is barely so; yet it is necessary because when an apprentice has finished his time, he may be sent out to a small roundhouse where he may be called upon to do some different job or operate a different machine daily; aside from that, however, an all-around training is necessary to produce a capable mechanic.

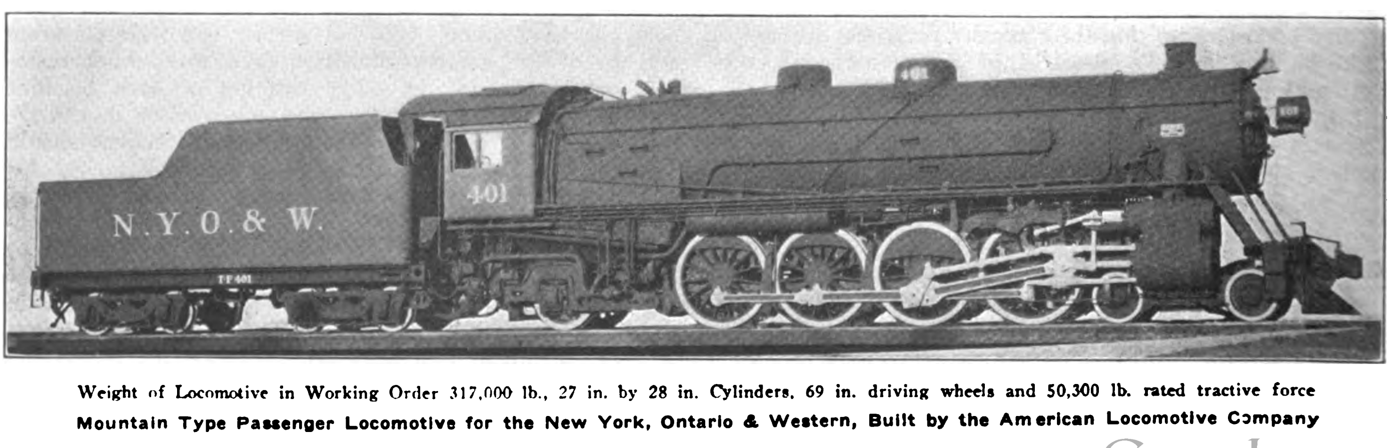
Advantages of Thorough Training

The value of apprenticeship training cannot be estimated in dollars and cents, for by the proper training of the apprentices the whole community is raised to a higher level of intelligence, ability and good will; also there is the advantage of having properly trained men to fill positions as foremen and officials in the company's service; men who are already versed in the standards and methods of the company are far superior to outsiders. Many companies complain that they give an apprentice a good training and then when he is finished he leaves them; generally, however, a good majority of the boys stay with the company, and, again, even if they do leave, they are started out in the world with the advantages of a good training. Of course, apprenticeship is only good so long as the apprentice has time to learn and the employer, or someone deputed by him for this specific purpose, has time to teach.

I think we ought to be very grateful to the company for what has already been done.

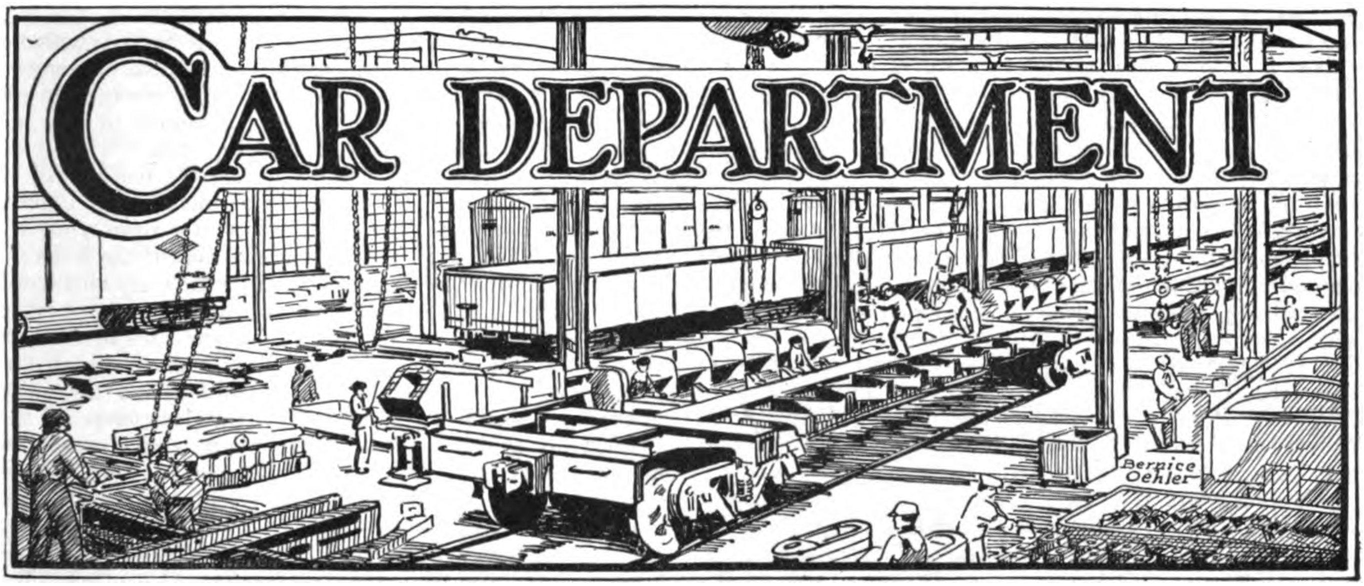
A Correction—J. Barraja-Frauenfelder

In connection with the article, "The Next Step Is the Thermo-Locomotive," which appeared on page 81 of the February issue of the *Railway Mechanical Engineer*, a brief biographical note was given showing the business connections and the work done by the author, J. Barraja-Frauenfelder. Through an oversight, mention was not made of the fact that he was the chief engineer of the Lake Torpedo Boat Company from 1914 to 1923. Mr. Barraja-Frauenfelder came to the country first in 1901, and returned to Italy in 1913 for a short time to accept the position of chief engineer of the Spezia Works of the Fiat-San Giorgio Company.



Weight of Locomotive in Working Order 317,000 lb., 27 in. by 28 in. Cylinders, 69 in. driving wheels and 50,300 lb. rated tractive force

Mountain Type Passenger Locomotive for the New York, Ontario & Western, Built by the American Locomotive Company



Ventilation and Heating of Passenger Cars*

Part I—Ventilation

Composition of Air, Factors Related to Required Volume of Supply, With Suggestions for Economical and Effective Ventilation

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THE ventilation and heating of railway passenger cars are subjects so closely allied that in order to understand one, it is necessary to have a fundamental knowledge of the other. Writers on these issues generally consider the problem of heating first and ventilation as a subject of secondary importance. It seems, however, that a correct understanding of the requirements for good ventilation should form a foundation for the study of the problem of heating passenger train cars.

Air consists chiefly of the two gases, oxygen and nitrogen with small proportions of other gases, such as carbon dioxide (CO_2), ozone, aqueous vapor and argon. Oxygen, which is the active constituent and upon which life and combustion depends, forms about one-fifth by volume of the whole, while nitrogen, which is inert, forms nearly four-fifths.

The carbon dioxide in the air amounts only to about .035 per cent by volume, but is generally assumed to be .04 per cent or 4 parts in 10,000. It is produced by the burning and decaying of vegetable and animal matters and by respiration. The percentage in the air remains practically constant because, under the influence of the sun, the foliage in the plant world assimilates the carbon dioxide and liberates free oxygen. All the carbon contents in plants, including trees and coal, originates solely from the carbon dioxide contained in the air. The assimilation process and the procedure which takes place during oxidation or burning, which in general includes respiration, are entirely opposite to each other. The assimilation process in the plant world produces from carbon dioxide and water an organic substance and free oxygen. When organic substances burn, decay, or are oxidized in the processes of animal life, carbon dioxide and water are again formed.

Water vapor is due to the oxidation process described and to the evaporation from bodies of water and also from the animal body. The amount of water contained in the air varies with the temperature and the available water supply. This vapor is not always sufficient to saturate the air. The ratio of the amount contained to that required for saturation is called "relative humidity," while the actual amount of vapor per cubic foot is known as the "absolute humidity." Thus at 75 deg. F., air may contain 0.00135 lb. or 9.5 grains of water vapor per cubic foot. This quantity will just saturate it. If the air is half saturated, the relative humidity is 50 per cent, and the absolute humidity is 4.75 grains to the cubic foot.

The proper and healthful relative humidity of air has only in recent years been given the thought and attention it rightfully deserves, despite its influence upon personal comfort and health. Water vapor is issued from the human body in two ways: In exhaled air when breathing and through perspiration. From 1½ to 2 lb. of water are evaporated daily from the skin of a person at rest. This evaporation as well as any other evaporation takes place due to application of heat. The source of heat in this instance is the human body itself and the rate of evaporation is affected by the motion, temperature and humidity of the surrounding air. Evaporation takes place by direct application of heat and is essentially a refrigeration or cooling process. Heat being abstracted from the body for this purpose naturally tends to lower the surface temperature and we actually feel several degrees cooler than the temperature recorded by the thermometer in the room. As heated or warmed air is expanded by heat, the percentage of moisture or relative humidity is lowered with the result that the capacity of the air for absorbing moisture is greatly increased. Under these conditions, we experience the sensation of dry heat. This causes

*Abstract of a paper presented at the meeting of the Canadian Railway Club held in Montreal, February 12, 1924.

an excessive and unnatural evaporation of moisture to take place from the skin and membranes of the respiratory organs.

The human body is a very sensitive power plant and it is obvious, therefore, that such an important function as perspiration can only act properly inside extremely narrow limits.

Fig. 1 shows the relation between temperature and relative humidity of rooms and their bearing on the comfort of the occupants. This chart establishes what is called the "comfort zone" in which the relation between relative humidity and the temperature is given by the equation

$R = 100 - 4\ (T-54)$
R = relative humidity
T = any temperature above 55 deg.

From this chart it is seen that a person can remain comfortable even though there exists a considerable variation in

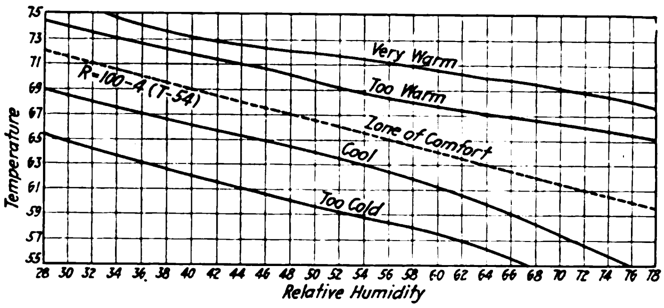


Fig. 1—Relation Between Temperature and Relative Humidity

temperature provided the relative humidity is such as to keep the dispersion of total heat from the skin constant. For this reason a thermometer can not alone be depended upon to measure comfortable air conditions for the occupants in a room because it does not include any measure of the moisture in the air. In order to measure the relative humidity and thereby ascertain a comfortable temperature, hygrometers, or wet bulb thermometers, should be employed to a much greater extent than at present. It may be that the future heat controls used in connection with heating cars will be regulated by means of hygrometers or, quite possibly, by a combination of thermometer and hygrometer. A heat control of this kind would undoubtedly result in a great saving of fuel.

Influence of Occupants on Temperature and Humidity

Respiration and the presence of the occupants in a room not only increase the carbon dioxide content in the air, but may add materially to the heat and moisture content of the air as shown in Table I.

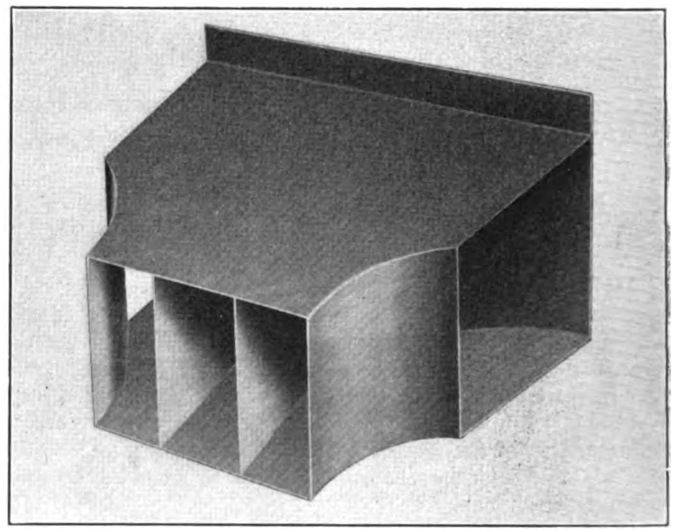
Table I.—Heat and Water Vapor Given off by People
(Harding and Willard)

	B. t. u. per hour	Water vapor per hour, lb.
Man at work	794	0.267
Man at rest	397	.155
Youth	357	.098
Infant	103	.029

All life processes are accompanied by the generation of heat from within. The blood serves to carry oxygen from the lungs to remote tissues, where combustion takes place, and carbon dioxide is carried back and eliminated by the lungs in respiration. As a result, an average normal temperature of 98.6 deg. F. is maintained. Normally, a uniform, but not too rapid, dispersion of heat must be maintained if the individual is to remain comfortable. The rate of dispersion by radiation, evaporation, etc., must equal the rate of heat generation. Hence it appears that the only function of external warming is to reduce the rapidity with which the body parts with or gives off its heat.

An average adult must throw off about 400 B.t.u. per hour for comfort, of which about 30 per cent is lost by contact with the air, 43 per cent by radiation and 27 per cent by exhalation and other means. A part of the 30 per cent, which is absorbed by the air coming in contact with the body, is carried off in water vapor. At a room temperature of 70 deg. F. and a relative humidity of 70 per cent, it will take at least four cubic feet of air per minute to carry off this water which is evaporated from the skin.

The radiation is noticeable to the sense of touch. Air, if dry, is a nearly perfect non-conductor but allows radiation to take place through it readily, hence, in a room with very dry air at 75 deg. F., a person may feel cold if the walls are at 50 deg. F. due to radiation loss from the body to the cold wall surfaces. This condition has an important bearing upon passengers in a railway car. Many cars of all steel construction are not properly insulated with the result that inside walls are cold and, notwithstanding that the inside temperature seems to be satisfactory, the passengers are uncomfortably cold or warm. Window sills and arm rests in all steel passenger cars are generally made of wood so as to avoid passengers coming in direct contact with the steel. This prevents a conduction of heat from the human body, but it does not eliminate the radiation. Designers of passenger cars should take into consideration what effect radiation has upon the comfort of passengers, when calling for new equipment. The ideal inside wall surfaces should, therefore, be either non-conducting, or serve as reflectors of heat rays, or should preferably combine both qualities.



Garland Type Ventilator

This will explain the use of a mirror finish employed on the interior of a vacuum bottle.

The gases and water vapor thrown off from a person under average room temperature conditions (70 deg. F. temperature and 70 per cent relative humidity) is of a higher temperature than the surrounding air and, therefore, lighter. Thus it will be seen that vitiated air will not fall to the floor as has often been presumed, but will naturally rise above the level of the breathing line and immediately diffuse itself into the surrounding air.

Effect of Carbon Dioxide Content on Required Air Supply

An adult at rest requires 20 cu. in. of air at each respiration and will make from 16 to 24 respirations per minute so that a total of from 320 to 480 cu. in. of air, or about 15 cu. ft. per hour, is required. This amount may be increased by exercise. Since this exhaled air contains about 400 parts of carbon dioxide (CO_2) per 10,000, an adult at rest gives off CO_2 at the rate of 0.6 cu. ft. per hour.

Hence in order to maintain the CO_2 content at a fixed

amount for each adult we must supply outside air containing 4 parts per 10,000.

$$C = \frac{a \times b}{n - 4} = \text{cu. ft. of outside air per min.}$$

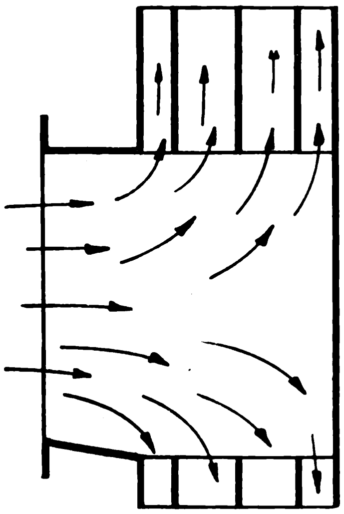
Where a and n = parts of CO_2 per 10,000 for respired air and standard of purity respectively; b = cu. ft. per hour of CO_2, the amount an adult at rest gives off, ordinarily 1.5 cu. ft.

Example: Assume it is desired to have the content of CO_2 in a room maintained at 10 parts in 10,000. How much outside air will have to be supplied for each adult?

$$\frac{400 \times 0.25}{10 - 4} = 16.6 \text{ cu. ft. per min. or}$$

$$16.6 \times 60 = 1{,}000 \text{ cu. ft. per hour}$$

In this case, therefore, it will require 1,000 cu. ft. of outside air per hour for each adult to maintain the CO_2 ratio



Air Currents in Honeycomb Type of Utility Ventilator

of 10 parts per 10,000 in an enclosed place. In the accompanying Table II, the CO_2 content has been calculated on the basis of 4 parts of CO_2 in 10,000 of outside air.

TABLE II—VALUES OF C FOR VARYING VALUES OF N FROM 5 TO 20

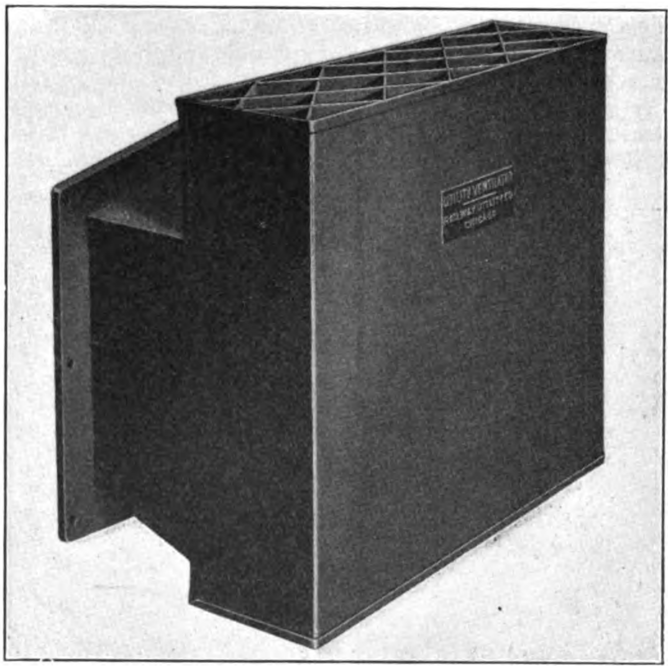
Vitiation allowed parts of CO_2 per 10,000 in the room air Parts (n)	Cu. ft. of air containing 4 parts of CO_2 per 10,000 to be supplied per person or equivalent a person = 0.6 cu. ft. CO_2 per hr. Per minute (C)	Per hour
5.0	100.0	6,000
5.5	66.6	4,000
6.0	50.0	3,000
6.5	40.0	2,400
7.0	33.3	2,000
7.33	30.0	1,800
7.5	28.6	1,714
8.0	25.0	1,500
9.0	20.0	1,200
10.0	16.6	1,000
15.0	9.1	545
20.0	6.2	375
30.0	3.8	231

The old theory that the sensation of discomfort arising in enclosed space was due to either an excess of carbon dioxide or an insufficient amount of oxygen, has been discredited. On the testimony of numerous experimenters, it has come to be generally agreed that an atmosphere containing less than three per cent of pure carbon dioxide and as high as 15 per cent oxygen, has no toxic effect and produces no distressing symptoms. It is very rare for the CO_2 produced by respiration to contaminate the air of any room, even with the poorest ventilation, to the extent of more than 50 parts in 10,000, which is one-half of one per cent. This amount of carbon dioxide alone has no harmful influence, according to the best available evidence.

In ventilation, the fact has been generally accepted that carbon dioxide in such amounts as is likely to be found in inhabited rooms, even up to 50 parts in 10,000, is in itself entirely harmless, but that when this is due to respiration, certain poisonous organic bodies are also present of which the carbon dioxide is an accurate index. The allowable amount of carbon dioxide as respiratory impurity has been variously placed at from 2 to 10 parts, which together with the amount already in the air, makes a total of 6 to 14 parts CO_2 per 10,000 of air. The limit is established by that degree of contamination at which the sense of smell begins to give the first indication of closeness to one entering the room from without. It has always been recognized that high standards of personal cleanliness would allow this limit to go higher than when such standards are low, that those within do not perceive any odor as readily as one entering, and that the contamination at which discomfort develops is susceptible to wide variations. As a result of their work, Haldane and Osborn recommended a limit of 12 volumes of CO_2 per 10,000 by day and 20 volumes by night when gas or oil is used for lighting. It has been generally stated that about 10 volumes of CO_2 in 10,000 allows a fair margin of safety. The ordinances for Chicago as they affect the ventilation of the street, elevated and suburban cars provides that the CO_2 content for a maximum loaded car shall not exceed 12 parts in each 10,000 parts of air.

Carbon Dioxide Content in Relation to Modern Car Ventilation

The most generally adopted measure of ventilation is the carbon dioxide standard in which the necessary amount of air for ventilation is figured from the amount probably



Utility Ventilator for Side-Deck Cars

emitted into a given space by its occupants, and the permissible amount that may exist in the air. Today, however, the attainment of this standard alone will not satisfy the requirements of modern ventilation.

The carbon dioxide content is controlled by the supply of air from outside the car. It is, therefore, necessary to ascertain the required air supply. We will take a 70 ft. coach and assume that the maximum number of passengers is 105, which is equal to one and one-half passenger per lineal foot. This allows for approximately 25 per cent above the seating capacity. The cross sectional area of an average passenger car is approximately 80 sq. ft. The CO_2 contents should not be more than 10 parts in 10,000 parts of air

which is equal to an air supply of 1,000 cu. ft. of air per hour per each occupant.

The air will therefore be changed:

$$\frac{1{,}000 \times 1.5}{80} = 18.5 \text{ times each hour in the car}$$

The total air supply in the car will be equal to

$$1{,}000 \times 105 = 105{,}000 \text{ cu. ft. per hour}$$

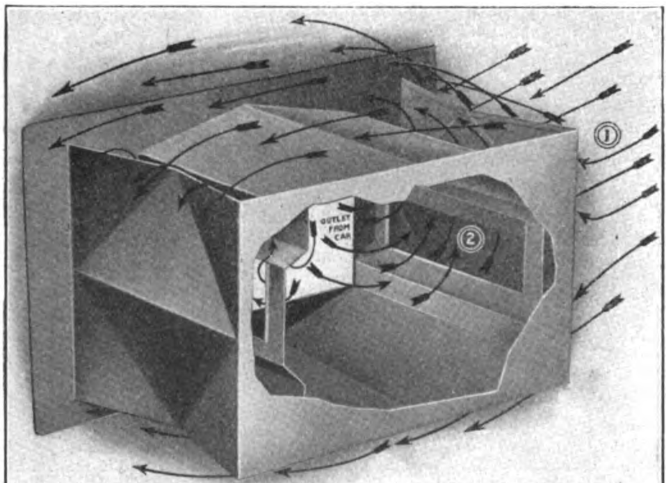
Several exhaust ventilators now on the market will discharge air at a rate of 15,000 cu. ft. or more per hour at a 20-mile train speed. The number of ventilators required will then be

$$\frac{105{,}000}{15{,}000} = 7 \text{ per car in the car body}$$

For a symmetrical arrangement of ventilators it would be desirable to use eight ventilators on a 70-ft. coach. It will, of course, be necessary to apply one ventilator in each toilet.

This number of ventilators probably is less than generally applied at present, but it is contended that in many instances the ventilation of passenger cars is overdone. With the incessant public fault finding with everything pertaining to a railroad, we have sometimes gone to unnecessary extremes in the matter of ventilation to please the traveling public.

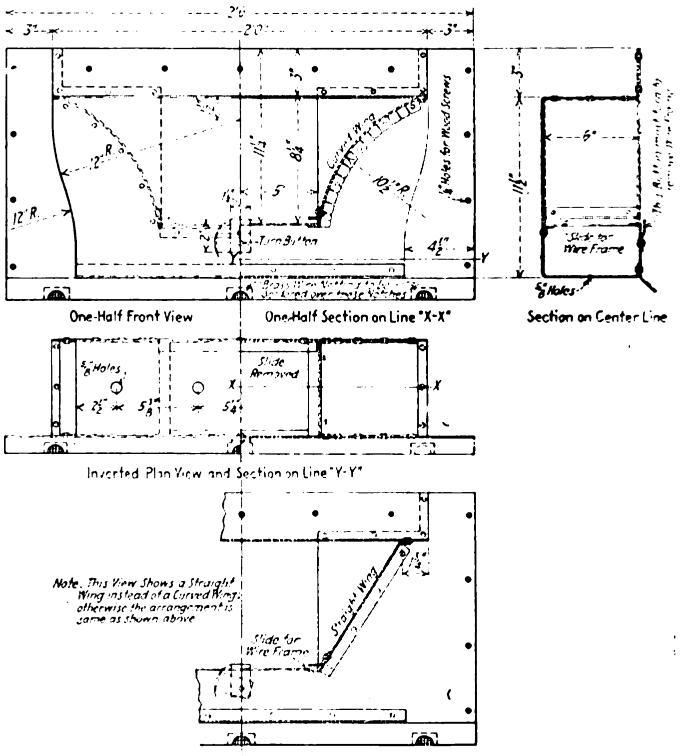
The application of too many ventilators wastes fuel, as a large volume of air will have to be heated for keeping the passengers comfortable, without adding materially to their well-being. There is also a real objection when too many exhaust ventilators are applied, as they create too great a vacuum. Excessive vacuum makes it difficult to close the doors and has a tendency to raise the water in the hoppers when flushed, as the air will rush into the car and splash the water into the toilet room, causing trouble and inconvenience. In a number of coaches recently constructed by a large railway system, the installation of a standard make of exhaust ventilators proved to be too powerful, as the water was raised in the hoppers when flushed. The doors and windows were



Arrows Indicate Air Currents in Mudge Ventilator

equipped with efficient weather stripping and to overcome the high vacuum created by the ventilators, air intakes had to be provided after the cars were placed in service.

In an ordinary passenger car, no intake is provided for as the small clearances around doors and windows are depended upon for inlets. It seems incredible that a volume of say 100,000 cu. ft. of air per hour could find its way through small crevices around closed doors and windows, but Dr. Crowder in his test of ventilation in sleeping cars has measured up to 30,000 cu. ft. per hour passing out through the ventilator duct from a small state room with the door and windows closed. Natural crevices are, therefore, sufficient air inlets if properly utilized and not too many ventilators installed, and they possess a vast advantage over larger openings. The incoming jets of cold air are individually so small and they take such irregular motions in mixing with the more quiet air within, that all the good effects of varied temperatures and motion are obtained without the disadvantages of uncomfortable cold draughts. Air coming through crevices around windows enters the car at or below the breathing zone and, therefore, at an ideal location. In some cars, particularly in sleeping cars, a small adjustable intake is provided in the bottom rail of the window sash. The location of this air intake is ideal and has the advantage



C., M. & St. P. Ventilator for Upper Deck

that the occupant of the seat can regulate the air supply to suit himself without causing discomfort to others.

Mechanical Refinements Required for Ideal Car Ventilation

Natural exhaust ventilators as applied in passenger cars depend for their operation upon the speed of the train. Therefore, they function only when the train is in motion. At slow speed and when the train is standing, they do not exhaust the necessary amount of air and at high speed are too powerful. These types of ventilators should have a compensating exhaust capacity. That is, after a predetermined capacity is reached, the area of the exhaust opening should be reduced to maintain a constant volume of air leaving the car. To take care of ventilation at a slow speed or when the train is standing, it would be desirable to install exhaust fans. These fans could, partially at least, be controlled by thermostats or probably anemometers. Exhaust fans should be installed in all smoking rooms and special fans are a necessity in kitchens of dining cars.

The ideal system for ventilating passenger cars would be to have the air, by mechanical means, forced into the car at a predetermined temperature and washed free from dust and bacteria. Unfortunately a passenger car is too small a unit to warrant the expense of installing such a plant. Several attempts have been made to provide cars with forced air intakes, but without success, as it draws into the car a considerable amount of dust and is also noisy. It may be

that in future passenger cars the heating system will be utilized in extremely hot weather, as a cooling system. This would greatly increase comfort in traveling, particularly when waiting for trains to leave at terminals.

In large buildings where washed and humidified air is forced into the rooms, it is comparatively easy to have the humidity under control, but despite the difficulty of applying the same methods to passenger cars, much could be accomplished in this direction toward increasing the comfort of travel. A great improvement in regulating the temperature of passenger cars could also be effected if hygrometers (wet bulb thermometers), were employed instead of using thermometers alone. Another practical possibility lies in the installation of a humidifier of simple construction in connection with the vapor heat. It is realized that it would be difficult accurately to control the humidity in a car, but a decided saving in fuel could be realized and conditions could be so much improved upon that serious consideration should be given to the latest possibilities suggested.

Heat control in a passenger car does, strictly speaking, not come under the subject of ventilation, but if the heat was properly controlled, the problem of ventilation would largely be solved. When passengers are uncomfortable and the car feels "stuffy" it is due, in the majority of cases, to overheating and unsuitable humidity. If the temperature were reduced and the steam shut off, the passengers would have immediate relief.

Dust is the most difficult feature to control in connection with the ventilation of cars. As previously mentioned, it has not proven practical to install air washing machines in passenger cars. During the greater portion of the year passengers will insist upon keeping windows and doors partly opened and during this period any air purifying system would be of no value.

Bacteria in the air is principally carried into the car with dust and, as in the case of dust, little can be done to exclude it. When we consider, however, that the train traverses mostly open country where the air is practically free from bacteria, the conditions are very satisfactory when compared with similar situations in city vehicles. It is, however, important to keep the cars clean. As a rule, this is carefully looked after by most railroads. The public, generally, knows nothing of the painstaking care put forth to keep passenger equipment in a sanitary condition. This, however, requires the constant attention of mechanical officers for if it is not followed up it naturally will be neglected.

Odors in the car, although in the majority of cases harmless, are disagreeable. Ventilation will reduce but not remove them. If the odor is due to a condition originating in the car itself, it is in the hands of the mechanical department to have the source removed, but if it originates from occupants with, for instance, a decided taste for garlic, we are confronted with a condition which cannot be remedied as long as the garlic lover remains in the car.

Diffusion of Air in Passenger Coaches and Sleeping Cars

Diffusion of the air in a passenger car with the ordinary system of ventilation has been proven by tests to be good. Air being a gas requires time to mingle and come to a mean temperature. Perfect diffusion of gases of varying temperatures and densities is not instantaneous, the time required varying inversely as the density and directly as the square root of the absolute temperature.

Air as a mixture, however, seeks different levels, according to its relative temperature. The influence of objects relatively hotter or colder than the air itself, therefore, may be employed to aid ventilation. Thus the cold area of glass in a window causes a downward current of air in its vicinity, while the heat from the human body gives rise to a general upward movement.

Air has a peculiar property to penetrate, for instance, clothing. It is generally conceded that the lower berth in a sleeping car is not as well ventilated as the upper berth on account of the former being entirely closed in by the berth curtain. Tests, however, have proved that the supply of air to the lower berth is really somewhat larger than in the upper, and there exists little difference between CO_2 content of the air in the aisle and in the berth. This condition is due to the ability of the air to diffuse and penetrate.

Economical and Efficient Ventilation

1. Carbon dioxide, CO_2, need not exceed 10 parts in 10,000 parts of air. This is equivalent to 1,000 cu. ft. of air per passenger per hour.

2. Humidity in the car should be controlled inside reasonable limits.

3. Heat should be controlled automatically with respect to the humidity in the air. Under no condition should the car be allowed to become overheated.

4. Air motion should be slight enough so that it is not annoying as a draft, yet strong enough to change the envelope of air around the body continuously, so as to maintain uniform evaporation at a constant temperature.

5. Dust should be kept out of the car as far as practical. Cars must be systematically cleaned daily. Where cars lay over at terminals, they should be thoroughly scrubbed and dusted both inside and outside.

6. Bacteria in a car will be kept down to a minimum if the car is kept clean and free from dust.

7. Odors can be controlled by the railroad only so far as this affects the sanitary condition of the car. Here, however, the conductor and the trainmen can be of considerable assistance by tactfully assigning passengers having a low standard of cleanliness to certain cars.

8. Diffusion of the air in the car will best be accomplished, under present systems of exhaust ventilation, by providing a plurality of very small inlets.

9. Ventilators in the car should be opened only in proportion to the number of passengers, so as to save fuel. If a proper ventilating system is installed, only half of the ventilators need be operated if the car is half full.

10. Rules should be issued to trainmen instructing them how properly to operate the ventilating systems in order to obtain the maximum comfort for the passenger at a minimum cost to the railroad.

DIFFERENT METHODS OF VENTILATION COMPARED SHOWING LARGER AIR SUPPLY WITH THE EXHAUST METHOD
(801 OBSERVASIONS IN 183 CARS)

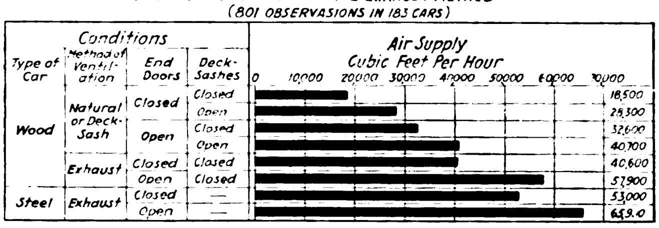


Chart No. 2—Average Ventilation of Sleeping Cars

11. Water seals in hoppers and in drain pipes from washstands and water cooler should be of sufficient depth to assure a perfect seal at all times. This is an important item in keeping the car in a sanitary condition.

12. In toilet rooms and probably in drawing rooms and compartments, efficient ventilation can be obtained by installing a chimney extending from floor to deck. At the floor, the chimney should be provided with a shutter and at the deck connected to an exhaust ventilator. With this system, odors are removed near the floor, thus minimizing their tendency to rise to the breathing zone. Incidentally, the

heat loss is at a minimum as the air is removed from the coldest part of the room.

Ventilating Systems Now in Use on Passenger Cars

The introduction of deck sash was the first attempt to provide for ventilation in passenger cars and then followed a variety of types of ventilators, practically all depending for their operation on the speed of the train. Therefore, they are only satisfactory at a certain speed and do not function when the train is standing in a station when, particularly in summer time, relief is needed most. This method of ventilation costs nothing to operate, neither does it accomplish entirely satisfactory results. In the summer doors and windows are opened which somewhat improves the condition, particularly when the train is in motion. Dr. Crowder has made extensive tests of passenger cars in respect to ventilation. These tests included cars equipped with deck sash and exhaust ventilators. Chart No. 2 shows these tests and represents the average air supplied, as determined from the CO_2 in the breathing zone, while cars were running in regular service at ordinary speed and with various possibilities as to air inlets and outlets. The significant bars of the chart, indicating where no intakes in addition to crevices were provided, are the first, fifth and seventh. Unaided by exhaust ventilators, the average car supply through

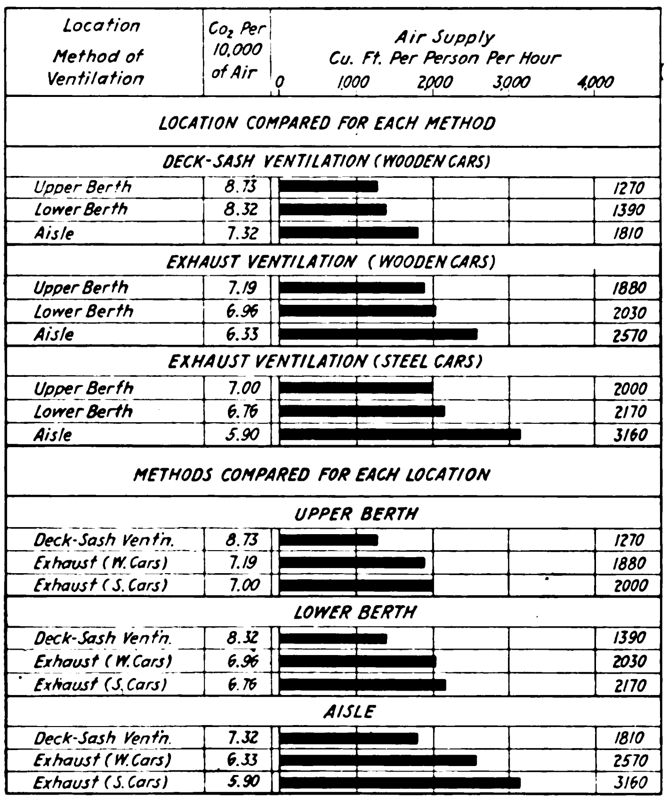


Chart No. 3—Relative Ventilation of Upper Berth, Lower Berth and Aisle

crevices alone was only 18,500 cu. ft. per hour, aided by exhaust ventilators the averages were 40,600 and 53,000 cu. ft. per hour for wooden and steel sleeping cars respectively. The difference between the latter two is believed to depend upon the almost total absence in the steel car of crevices in its upper portion, by reason of the absence of deck sash and a consequent absence of short-circuiting of air currents from deck sash crevices to ventilators necessarily close at hand. There is in consequence a more constant withdrawal from below and a more rapid changing of air of the lower levels, particularly at the breathing zone where it is most needed. A study of this chart will reveal that cars equipped with deck sash only provide a fair average ventilation in sleeping cars. Chart No. 3 shows the average air supply per occupant and the CO_2 content in the car at different locations. Where tests were made of CO_2 contents in a berth it had but one occupant. Each group in the chart represents an average of 16 passengers in each car. Where ventilators were used, six were installed in each car. It should be noted that these charts represent average conditions and include regular stops of train in service. Therefore, both the volume of air supplied and the CO_2 content vary considerably.

Any type of ventilation will function satisfactorily within certain limits if it is maintained in working condition. However, the simplest system with deck sash can be rendered inoperative by allowing it to clog up. An inspection will often reveal that the deck screens are filled with dirt hardly allowing any air to pass through. The same condition often exists with ventilators having screens, even the air ducts in the ventilators themselves are often filled with dirt and cinders. Under those conditions, not much relief can be expected from the ventilating system.

Granting, however, that the ventilating system is in first class condition and the car is delivered to the terminal in a clean, sanitary condition with correct temperature, the train departs from the depot but in a very short time the car is stuffy. What has taken place? The conductor has turned on all the steam he can and probably opened one or two deck sash or ventilators. What he should probably have done was to have turned off all the steam and opened all the ventilators and probably the windows in the end doors. Trainmen should be guided by indicating instruments such as hygrometer and thermometer combined to give instant reading of the degree of comfort in the absence of automatic control.

Recommendations

The first two recommendations submitted will improve the present system without any cash outlay. The other recommendations are to some extent contingent upon the amount the railroad is able to set aside for improvement to rolling stock.

1. Keep deck screens and ventilators clean—regular periodical cleaning.
2. Educate trainmen how to use deck sash or ventilators for the comfort of the occupants of the car and that overheating means discomfort to passengers and loss of money to the railroad company.
3. Install exhaust fans in smoking rooms and kitchens of dining cars.
4. Close up permanently all deck sash and install natural exhaust ventilators in body of car and in toilet rooms. It would be desirable to supplement the ventilators in the body of the car with at least two exhaust fans.
5. Install automatic heat control to prevent discomfort of occupants from overheated cars and loss of money by the railroad.

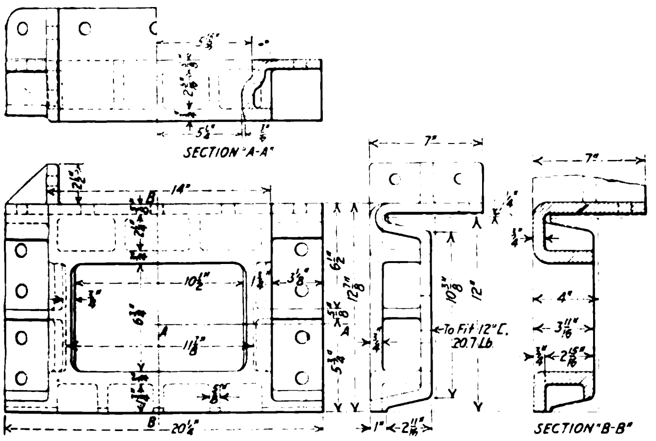
(Part II, dealing with the heating of passenger cars, will be given in the next issue.)

Bulletin Number Six, issued by the Railway and Locomotive Historical Society, 6 Orkney Road, Brookline, Mass., shows the Carrollton Viaduct, on the Baltimore & Ohio, near Baltimore, as it existed in 1829, with one car, drawn by a horse, passing over it. The most prominent article in the issue is a list of locomotives as reported to the Congress of the United States in the year 1838. It appears that this was made up by the Treasury Department, at the request of the House of Representatives, and no doubt is quite complete. It includes stationary engines and the engines of steamboats as well as railroad locomotives, and the total number is over 3,000. The number of locomotives is about 350. Fifty-four railroads are named, and 39 builders. Of the builders, 11 are English manufacturers. The principal American shops represented were located in Lowell, Philadelphia, Boston, New York, Paterson and Baltimore.

57½-Ton Hopper Bottom Gondola for C. & O.

Careful Designing Increases Strength, Substantiability and Capacity With Little Addition in Weight

THE first lot of new steel freight cars built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., was 1,500 steel hopper bottom gondola coal cars for the Chesapeake & Ohio. As these cars were not duplicates of any previously built cars, it was necessary to prepare new designs in order to incorporate the general features specified by the railway company. This work was done under the direction of S. B. Andrews, afterwards appointed mechanical engineer of the Chesapeake & Ohio.



Striking Casting and Drawbar Carrier Are Combined in a Single Steel Casting

While the Newport News Shipbuilding & Dry Dock Company already had carried on successfully the general overhauling of locomotives and had rebuilt a considerable number of freight cars, the construction of new cars in 1923 was not begun until the problems involved had been given careful consideration and the plant prepared to undertake the work. Shops were re-arranged, with the existing machines suitably placed or new machines purchased and installed for the orderly movement of materials from receiving platform to assembly tracks.

All work was jigged and every precaution taken to insure interchangeability of sheets and parts in order to facilitate erection, which was carried on by the most approved station to station system. The building of this lot of cars was completely scheduled and consequently the work was carried on as a strictly manufacturing proposition. The success of the manner in which the design was prepared and the cars constructed demonstrates the careful and thorough manner in which car building was considered.

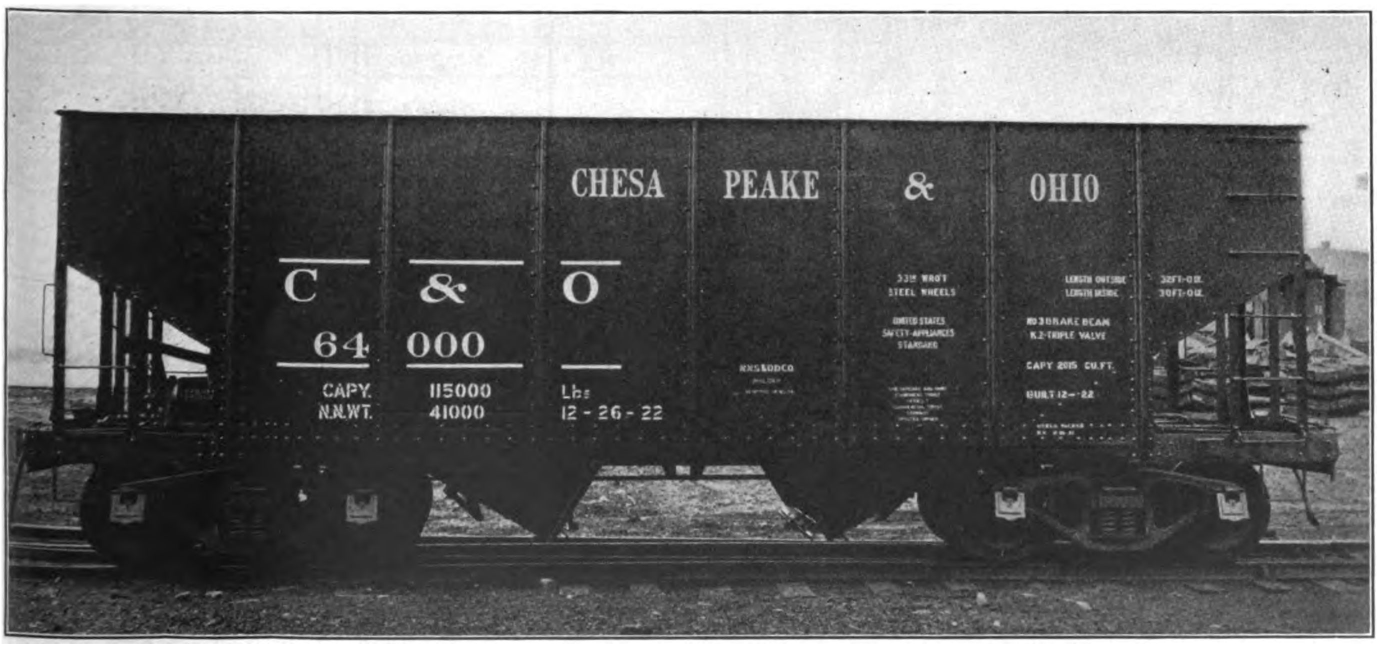
These cars represent the best and most modern features of car construction. As the tonnage of the trains operated on the C. & O. is unusually heavy and as a large number of 70-ton and 90-ton cars are in use, the cars are subjected to severe strains.

The experience of the railroad with cars previously built indicated the possibility of certain improvements that would add to the strength and durability. After a thorough investigation, the new design was prepared and a number of modifications incorporated.

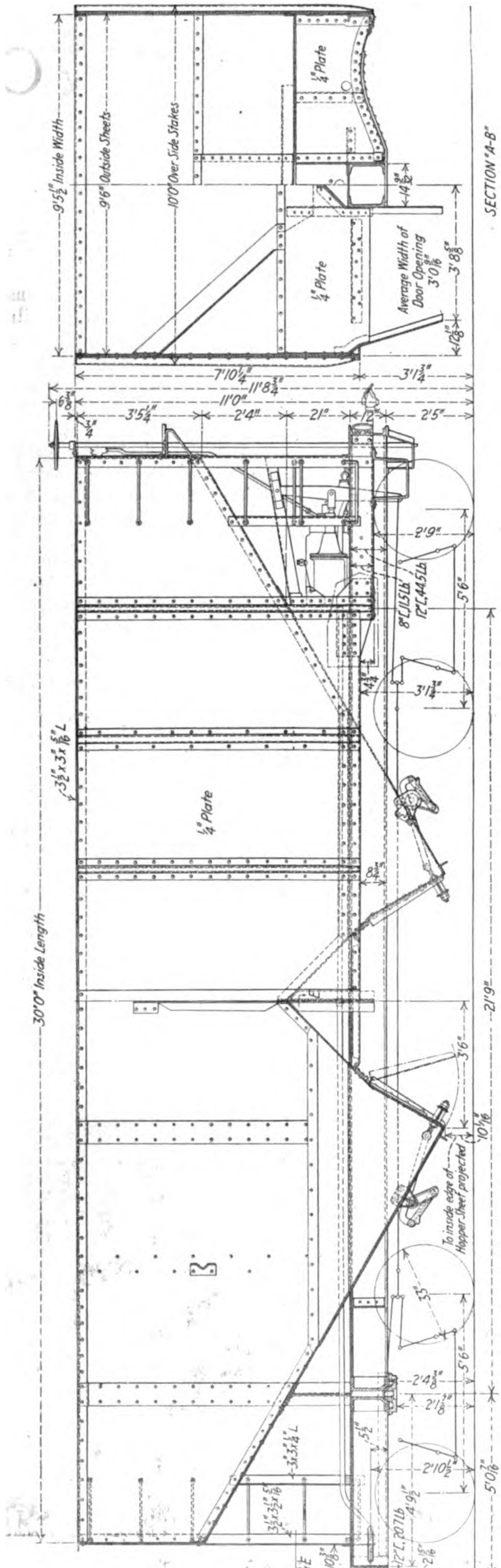
Heavy Sills and Substantial Draft Gear Attachment

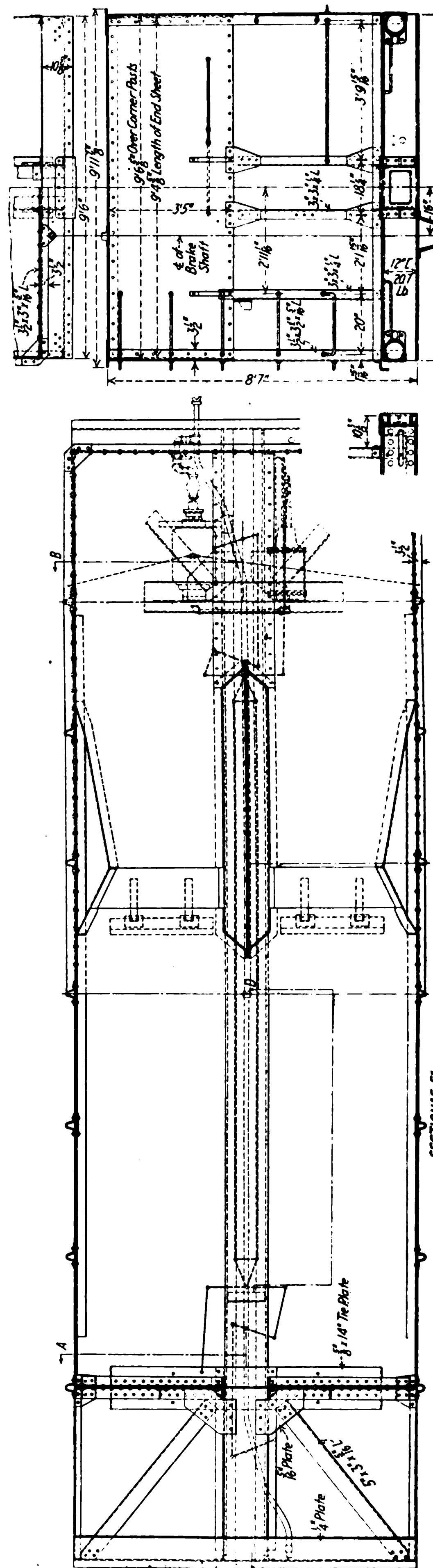
Particular attention was given to the strength of the center sills and the construction of the draft gear attachments. In place of following the usual practice of using center sills of 12 in. or 15 in. in depth, weighing from 33 lbs. to 35 lbs. per foot and reinforced by angles riveted to the bottom of the sills, these cars have 12-in. channel iron sills, weighing 44.3 lbs., which are sufficiently heavy not to require reinforcing angles.

Advantage was taken of the thicker webs of the sills in providing additional bearing area for rivets and the draft stops were attached by 1⅛-in. rivets in place of ⅞-in. rivets, which is the almost invariable practice. In using the smaller rivets, made necessary by the thinner webs of older designs,



These Cars Are Stronger and of Greater Capacity Than Previous Cars of the Same Weight

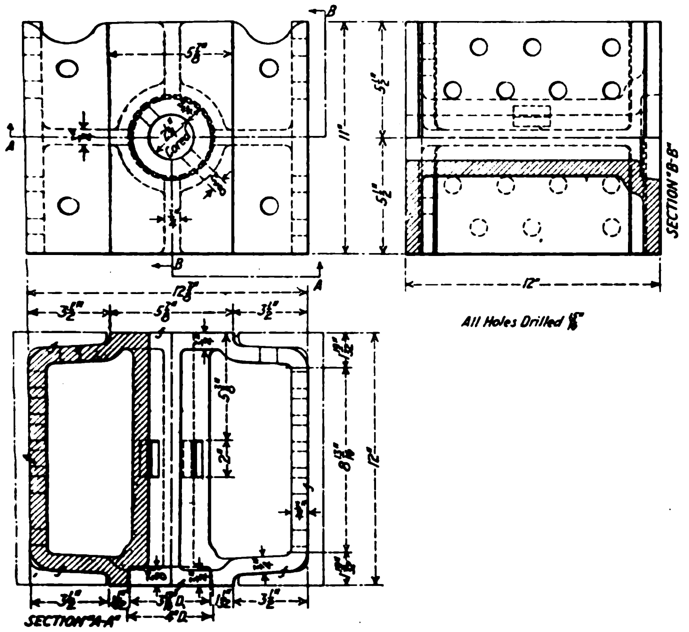




Elevation, Plan and Sections of the C. & O. 57½-Ton Hopper Bottom Gondola

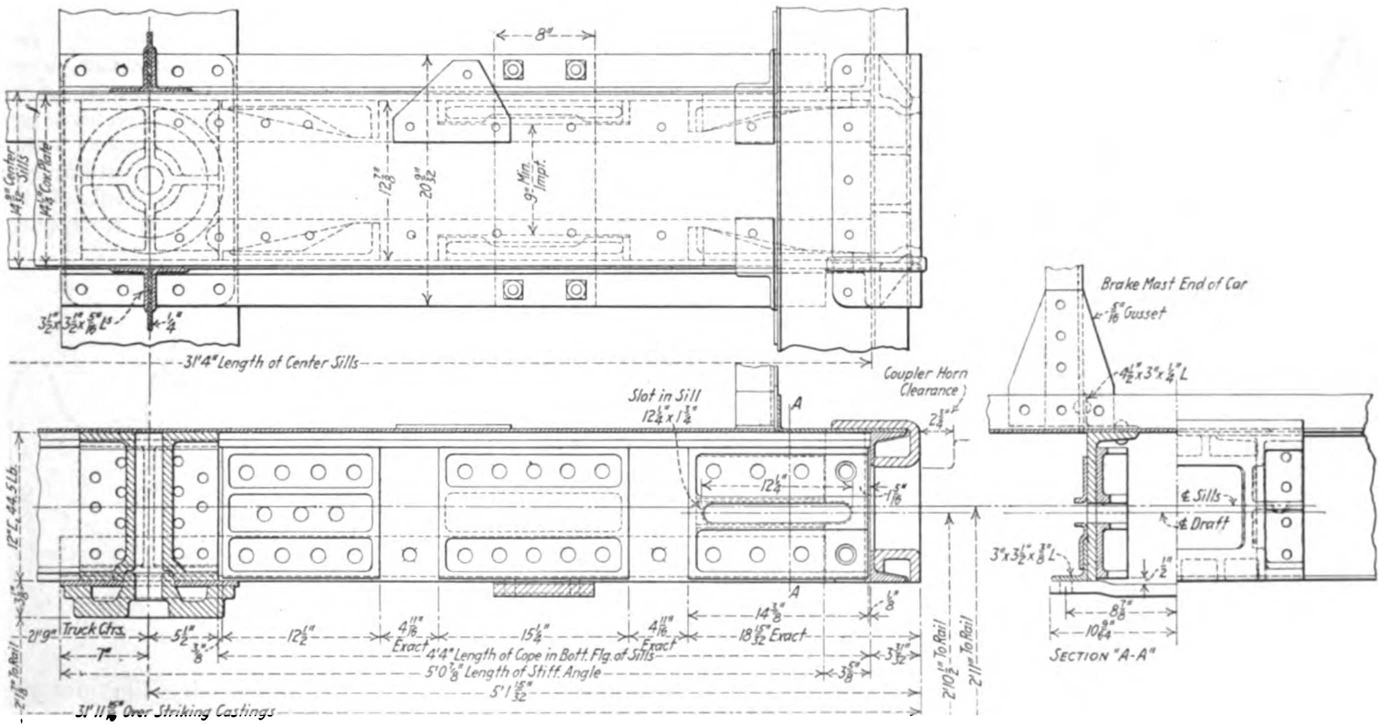
it was realized that with all the rivets possible to be applied, the draft gear attachment was not as strong as desirable. The use of the larger rivets results in a very substantial improvement in this respect, while the number of rivets is reduced.

Most hopper cars have end sills much lighter than the



The Body Bolster Center Brace Is Machined to Fit Sills and Plates

center sills and in many designs the end sill is considerably weakened by the cut out made for the drawbar. In this design, the end sill is of the same depth as the center sills and is located on the same level. A rectangular cut through

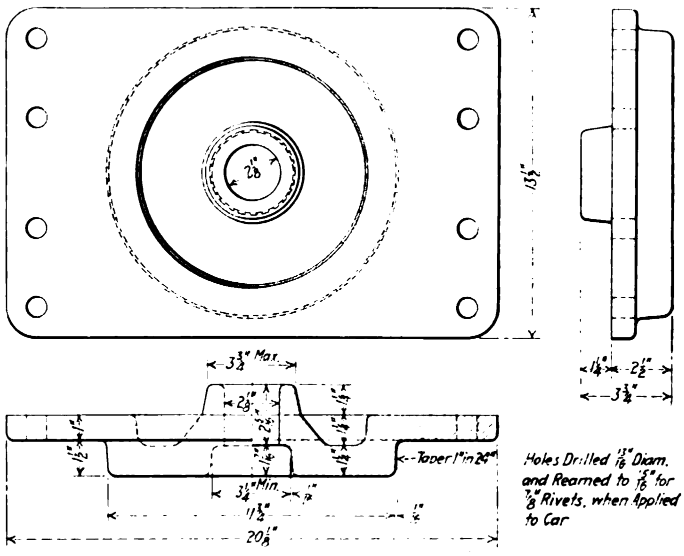


Center Construction from Bolster to End—Center Stop Lugs Come Into Use When Gear Goes Solid

the middle of the web for the drawbar does not appreciably weaken the end sill, however, the striking casting and the drawbar carrier are combined in a single steel casting, which fits between the flanges of the end sill and bears against the web, which, in turn, has a full bearing over the entire end faces of the center sills.

Center Plates and Bolster Brace

The experience of the railway with previous designs indicated that stronger center plates and a better support for



Center Plates Are Drop Forged and Unusually Heavy

the center plates was desirable. The center plates on these cars are drop forged and are heavier than is the usual practice, being 1¼ in. thick over the bowl, and are securely anchored by extending up into the center brace.

The weight of the car is transferred from the body bolster to the center plate through a cast-steel center brace, which was accurately machined to fit between the flanges of the center sills and also against the top bolster cover plate and center plate.

These cars are another step in the direction which car design has been progressing steadily since steel freight cars

came into common use, that is to build stronger and more substantially.

Below is given a comparison of the sills on three similar hopper bottom gondola cars of different ages, all built in the past few years. The oldest, built in 1912, is a good average example of a design used generally at that time. The next car is the car designed by the U. S. R. A. and built in 1919. The last represents the cars built at Newport News in 1923.

Comparison of Sills in Different Designs

	55-ton 1912	55-ton U. S. R. A.	57½-ton Newport News
Sills	15 in.—35 lb.	12 in.—23 lb.	12 in.—44.3 lb.
Area center sills	18 sq. in.	25.5 sq. in.	31 sq. in.
Ratio end stress to end load	.133	.0512	.0486
Draft stop rivets	24—⅞ in.	44—⅞ in.	38—1⅛ in.
Rivets, area	16.57 sq. in.	30.37 sq. in.	42.09 sq. in.
Rivets, bearing	9.675 sq. in.	19.387 sq. in.	32.21 sq. in.

Center Draft Gear Stops

In addition to the usual front and rear draft gear stops, these cars have center stop lugs which come into use when the gear goes solid. These are secured by 20 1⅛-in. rivets, which adds very substantially to the values given in the table.

In order to resist the effects of corrosion, all the plates ¼-in. or less in thickness, are of copper bearing steel.

The trucks are of the Andrews type with Bettendorf cast steel side frames, U type, with integral journal boxes. They have Simplex truck bolsters; A. R. A. class D double coil truck springs; A. R. A. No. 3, 18,000 lb. brake beams; and 33-in. diameter wrought steel wheels.

The cars also are equipped with Symington door operating mechanism; A. R. A. type D couplers, with 6-in. by 8-in. shanks; Westinghouse type D-3 friction draft gear, and Westinghouse schedule KD-1012 air brakes.

The general dimensions of the three designs are shown in the table.

	55-ton 1912	55-ton U. S. R. A.	57½-ton Newport News
Length over striking castings	31 ft. 6 in.	31 ft. 11 in.	31 ft. 6 in.
Length inside body	30 ft. 0 in.	30 ft. 6 in.	30 ft. 0 in.
Width over side stakes	10 ft. 0 in.	10 ft. 1 in.	10 ft. 0 in.
Width inside car body	9 ft. 5½ in.	9 ft. 5½ in.	9 ft. 5½ in.
Height from rail to top of body	10 ft. 0 in.	10 ft. 8¼ in.	11 ft. 0 in.
Height from rail to top of brakemast	10 ft. 9¾ in.	....	11 ft. 9¾ in.
Distance center to center of trucks	21 ft. 9 in.	21 ft. 11 in.	21 ft. 9 in.
Truck wheel base	5 ft. 6 in.	5 ft. 6 in.	5 ft. 6 in.
Size of journals	5½ ft. 10 in.	5½ ft. 10 in.	5½ ft. 10 in.
Type of truck	Arch bar	Andrews	Andrews
Coupler shank	5 in. by 7 in.	6 in. by 8 in.	6 in. by 8 in.
Cubical capacity	1,731 cu. ft.	1,880 cu. ft.	1,955 cu. ft.
Light weight	36,000 lb.	40,750 lb.	41,700 lb.

Gaging Wrought Steel Wheels for Car and Tender*

Discussion on Use of New A.R.A. Steel Wheel Gage for Determining Defects, Turning Wheels and Billing

By Arthur Knapp

Assistant to Consulting Engineer, New York Central

As we consider the change in practice required by the new rules of the American Railway Association, it will be necessary thoroughly to understand some of the terms used in referring to certain portions of the wrought steel wheel rim, for example: front face, back face, measuring line, rim thickness, and interior diameter, (front and back) as illustrated in Fig. 3.

Effective March 1, 1924, the "limit of wear groove" cut thickness of the rim between the *inside edge of the back face of the rim* and the line on the tread at which a line drawn through the intersection of the line *A-B* and the tread of the wheel, parallel to the axis of the wheel, meets the *back face of the wheel rim.* This measurement must be taken with a standard A. R. A. steel wheel gage or a gage of similar type approved by the A. R. A. to conform with the A. R. A. Interchange Rules effective March 1, 1924, Fig. 3.

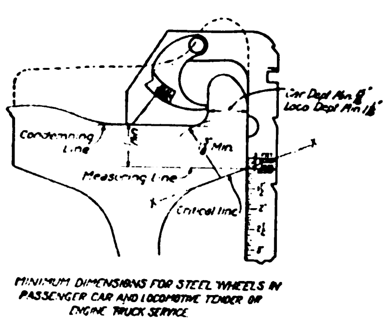


Fig. 1A

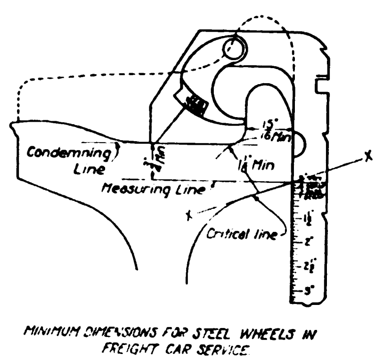


Fig. 1B

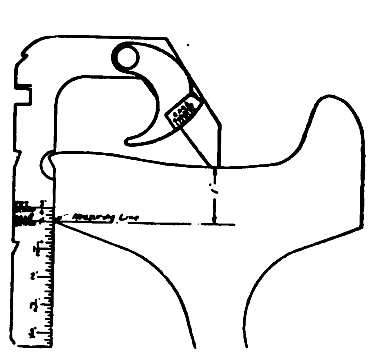


Fig. 2

on a line ¾ in. from the inner edge of the *front face of the rim* of all wrought steel wheels will be disregarded in taking measurements to determine rim thickness.

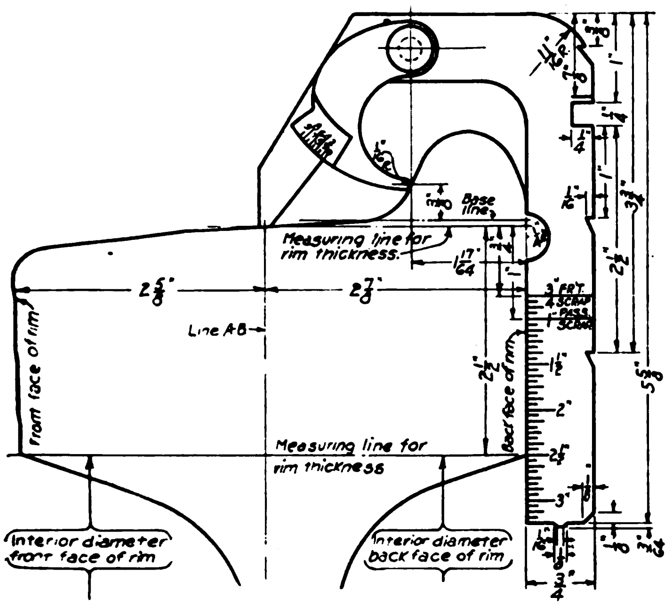
Effective January 1, 1924, all measurements involving the thickness of the rim of wrought steel wheels must be taken on the *back face of the wheel rims* so as to determine the

*Abstract of a paper presented at the December meeting of the Car Foremen's Association of Chicago.

Effective March 1, 1924, the condemning limit for rim thickness for wrought steel wheels used in passenger car, locomotive tender and engine truck service will be 1 in., Fig. 1A. The condemning limit for rim thickness for wrought steel wheels used in freight car service on all axles up to and including "E" axle with a 6 in. by 11 in. journal will be ¾ in., Fig. 1B. These condemning limits are indicated on the long leg of the A. R. A. gage by two horizontal

lines. A line to indicate the condemning limit for passenger car, tender and truck wheels is marked "*passenger scrap,* 1 in." and the line to indicate the condemning limit for wheels used in freight service is marked "*freight scrap,* 3/4 in."

The Wheel Committee considered the difficulty that might be experienced in attempting to apply the standard steel wheel gage to the back of the flange of wheels in the middle



STEEL WHEEL GAGE
For use in measuring tread thickness amount of metal to be turned off tread to restore flange contour, and limit of depth and location of witness groove in flange, slid flat spots, vertical flanges, chipped rims and ax'e collar thickness.

Fig. 3—A. R. A. Standard Gage for Wrought Steel Wheels

of a 6-wheel truck, and it is therefore designed so that it may be applied when occasion requires to the front face of the rim (Fig. 2); but the rules specify that the final measurements for rim thickness must always be taken on the back face of the rim.

New York Central Practice

The instructions issued to all New York Central shops in connection with the changes effective January 1 require that

2. The amount of metal it will be necessary to turn from tread and flange contour.

3. The amount of metal that will remain for service after turning.

The application of the gage to a worn flange of a steel wheel will be indicated, as illustrated in Fig. 4, the gage to be applied at two or more points to determine the point of greatest flange wear. The reason for this requirement is the variation in flange thickness disclosed during experiments with the steel wheel gage.

To determine rim thickness and amount of metal it will be necessary to remove from the tread to restore a standard tread and flange contour, the long leg of the gage must be applied *snugly* against the *back face of the rim,* and the short leg must rest on the tread of the wheel. The reading on the long leg at the point of intersection with the underside of the rim will indicate the over-all rim thickness. The moving finger on the short leg must then be adjusted until the point rests against the face of the flange. The graduation on the moving finger nearest to the point of intersection between the scale on the finger of the gage and the short leg represents the number of sixteenths to be removed from the wheel tread to restore a standard tread and flange contour with a witness mark in the face of the flange within the prescribed limits. The rim thickness of the wheel *after turning* may be determined *before turning* by subtracting the reading on the graduated finger of the gage from the scale reading on the long leg; for example, in illustration, Fig. 4, the scale on the long leg intersects the measuring line at 1-13/16 in. which is the rim thickness over all. The position of the gage finger indicates it will be necessary to remove 7/16 in. of metal to restore tread and flange contour. Deducting 7/16 in. from 1-13/16 in. gives 1 3/8 in., which represents the rim thickness that will remain after the wheel is turned. As the condemning limit for rim thickness for passenger car, engine tender and truck service is 1 in., 3/8 in. of metal will be available for service after turning. If the wheel is to be applied to a freight car, the metal available for service after turning will be 1/4 in. additional. Rule 101 of the A. R. A. indicates the value of each 1/16 in. of metal available for service in the rim of a wrought steel wheel applied to freight car service as $1.52; and the value of each 1/16 in. of metal available for service in the rim of a wrought steel wheel applied to passenger car service is $2.04. These prices may be modified somewhat for 1924.

All concerned in the turning, mounting, and re-application

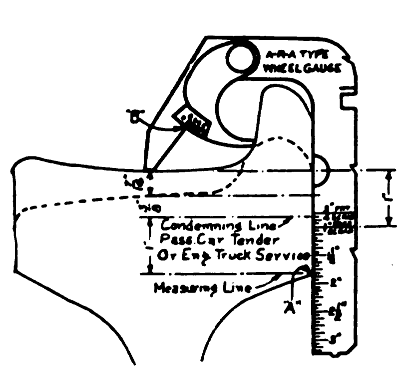
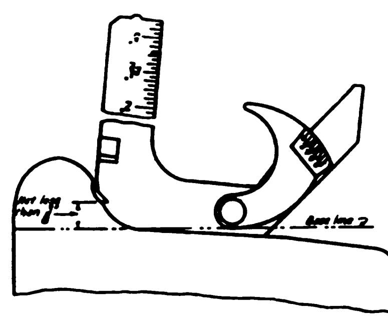
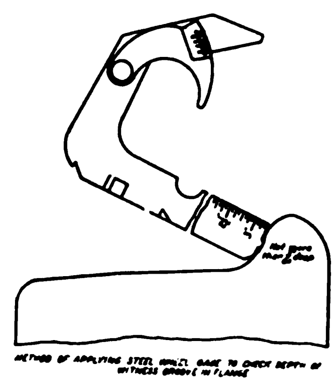


Fig. 4



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK LOCATION OF WITNESS GROOVE IN FLANGE

Fig. 5



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK DEPTH OF WITNESS GROOVE IN FLANGE

Fig. 6

the standard steel wheel gage must be used without exception to determine:

1. Whether worn steel wheels removed from any class of service should be—(a) Turned and re-applied to passenger car or engine tender or truck service. (b) Condemned for passenger car or engine tender or truck service but set aside for the reclamation for use in freight car service. (c) Condemned for all service and scrapped.

of wrought steel wheels should use good judgment to avoid unnecessary waste of service metal. Instructions issued to New York Central shops require the use of the steel wheel gage for all calculations and operations incident to turning wrought steel wheels and require that the following practice be carefully observed.

1. When the point of intersection between the finger and the short leg of the gage is between two graduations, the

lowest reading must be taken as the basis for turning operation.

2. Deduct at least 1/16 in. from the gage reading so obtained to establish the depth of the rough cut and use the finishing tools to remove such additional metal from tread and flange as may be necessary to obtain a standard contour. A witness mark should appear on the face of the flange of every wheel turned on account of flange wear as proof of good workmanship. The lower edge of such witness mark must be at least ⅜ in. above the tread. The width of the mark should not exceed ⅜ in., and the depth must not exceed 3/64 in. The location and depth of witness mark must be checked by application of the gage as illustrated in Figs. 5 and 6.

The loss in service metal involved in restoring a standard tread and flange contour of a worn wheel is greater than that involved in any other wheel turning operation; for example, when the flange thickness is reduced to 15/16 in., ½ in. must be removed from the tread to restore a full flange. Usually the mate wheel is in such condition that a standard tread and flange may be restored with a loss of ⅛ in. or 3/16 in. service metal. Frequently this waste may be avoided by dismounting, remating and remounting flange worn wheels, and we have recommended a study of shop conditions to provide facilities when such practice will result in a saving of service metal with a value in excess of the cost of the operation. Twelve pairs of flange worn wheels recently removed from service for turning in one N. Y. C. shop were measured with the A. R. A. steel wheel gage and then were dismounted, remated and remounted to avoid unnecessary waste of service metal. The average saving was 5/16 in. per pair of wheels, representing a saving of approximately $9.00 per pair after deducting the cost for dismounting, remating and remounting.

When wheels are sent to the shops for turning on account of shelled spots in the treads, the depth of the defect should always be determined by a rough cut before an attempt is made to turn both wheels to an equal diameter for re-application. Frequently shelled spots require a cut of ½ to ¾ in.; and if both wheels are turned, a serious loss is involved in connection with the reduction in rim thickness of the sound wheel mated with the defective wheel.

A. R. A. Rules require the use of the wheel gage to determine the amount of metal charged to a delivering line in connection with wheel turning to correct slid flat spots. The method to be used is illustrated by Figs. 7 and 8. Fig. 7 shows the gage applied at the center of a slid flat spot, and Fig. 8 shows the gage applied at some other point on the tread. The scale on the long leg, Fig. 7, indicates the over-all rim thickness as 1-7/16 in., and the scale on the long leg, Fig. 8, indicates the over-all rim thickness as 1-9/16 in. In this illustration ⅛ in. (the difference between the two readings) plus 1/16 in. of tread metal must be charged to the delivering line on account of the slid flat spots, and ¼ in. must be charged against the owning line on account of restoring flange contour. The extra 1/16 in. charged for the flat spot is made to allow for cutting under the hard surface in the center of all slid flat spots.

The gage may also be used to determine: (a) The length of slid flat and shelled spots—wrought steel, cast steel, or cast iron wheels, as indicated in Fig. 9. (b) Flange wear and vertical flanges: Rule 74 in the Code of Rules will be revised to read as follows:

Worn Flanges—Cast Iron Wheels: Under cars of less than 80,000-lb. capacity with flanges having flat vertical surface extending 1 in. or more from the tread, or flanges 15/16 in. thick or less, gaged at a point ⅜ in. above the tread.

Wheels under cars of 80,000-lb. capacity or over, with flanges having flat vertical surface extending ⅞ in. or more from tread, or flanges 1 in. thick or less, gaged at a point ⅜ in. above the tread.

Worn Flanges—Wrought Steel, Steel Tired, or Cast Steel Wheels: Flanges having flat vertical surface extending 1 in. or more from tread, or flanges 15/16 in. thick or less.

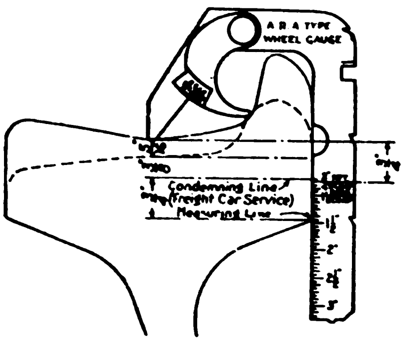


Fig. 7

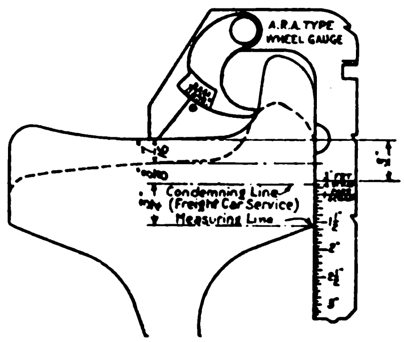


Fig. 8

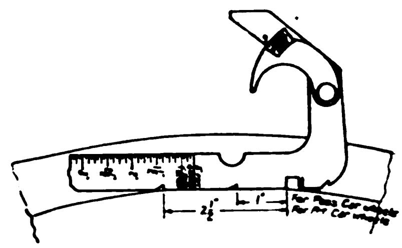


Fig. 9

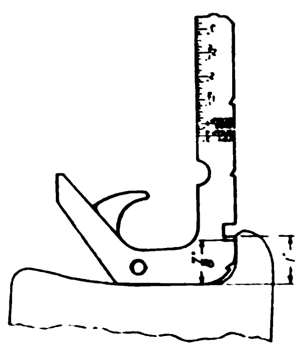


Fig. 10

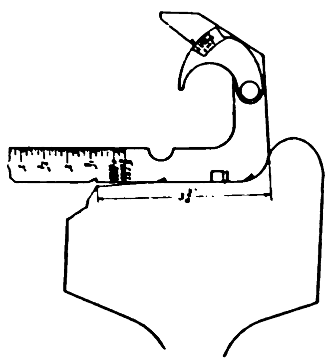


Fig. 11

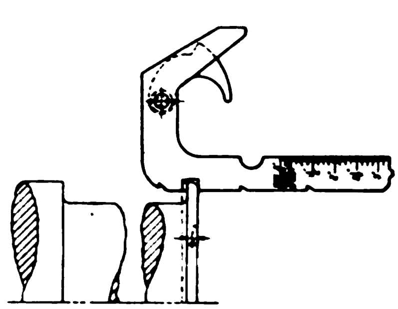


Fig. 12

The use of the gage to determine height of flange is illustrated by Fig. 10, and flange thickness may be determined on steel wheels by setting the finger at graduation No. 8.

(c) Rule 72 will be revised to describe a chipped rim as "Any circumferential seam within 3¾ in. limit from flange. This may be determined by applying the gage as illustrated in Fig. 11.

(d) The application of the gage to determine limit of wear on journal collars is illustrated by Fig. 12.

(e) Coupler wear may be checked when necessary by shortening the leg 5⅛ in. It will be understood, however, that this will shorten the scale on the leg and the gage should not be mutilated if there is any liability that it will be required for use in turning operations.

As the condemning limits for rim thickness effective January 1, 1924, for wrought steel wheels in freight car service will be ¾ in. for all axle sizes up to and including the 6 in. by 11 in. journal, a large percentage of the wheels removed from passenger car and tender service may be re-turned and re-applied under freight cars, provided removal from service is not occasioned by a defect that would render the wheel unfit for further service.

Experiments indicate that wheels reclaimed may be used to the best advantage when remated and remounted on axles with 5½ in. by 10 in. journals for application under 100,000-lb. capacity cars. To avoid unnecessary dismounting and remounting, all wheels removed from either passenger car or tender service on 5½ in. by 10 in. or 6 in. by 11 in. axles, should be held on such axles for re-turning for application to freight service, provided both wheels of the pair will turn with at least ⅛ in. to 3/16 in. service metal available for freight service.

When one wheel of a pair of wheels mounted on a 5½ in. by 10 in. or 6 in. by 11 in. axle will not turn with the required amount of service metal over the proposed ¾ in. condemning limit, then both wheels should be dismounted to release the axle for further service.

All wheels mounted on axles with journal sizes less than 5½ in. by 10 in. should be dismounted at point of removal and axles released for other service.

Prior to remounting, all wheels must be inspected to eliminate defective wheels and to avoid mating wheels which will not turn to equal diameters with approximately the same amount of service metal after turning. The general rule should require that all wheels suitable for re-turning for re-application to freight service be assembled at some shop properly equipped for the various operations involved. All wheels mounted on 5½ in. by 10 in. or 6 in. by 11 in. axles to be shipped as removed from service; all others to be dismounted and shipped as loose wheels in carload lots.

Norfolk & Western Practice

There is one feature not mentioned in the paper in particular, and that is the man in charge of the reclaiming process. He may have several carloads of wheels. The wheels will vary in diameter and rim thickness, the flanges will be thick and thin. He will have to remate those wheels and remount them on an axle and send them to be turned. Now, if he mounts a 33 in. wheel and a 36 in. wheel with the same rim thickness together on the same axle, the mounting operation will be a loss even though he turns them down together. The N. & W. have been following this practice of remating and remounting wheels for a number of years. Their Mr. Cook has worked out a table of tape sizes and variations in the rim thickness, which I believe is copyrighted. This can probably be obtained by writing to Bernard Cook, assistant engineer of tests, Norfolk & Western, Roanoke, Va. I refer to that table because at one time it was presented to the Wheel Committee and shortly afterwards recalled by the superintendent of motive power of the N. & W. with the statement that Mr. Cook desired to copyright it. We have prepared tables for the N. Y. C. which show the reduction in tape size on wheels based on the reduction in rim thickness. I have not incorporated that table in the paper, however, because I believe the simplest way is to base the necessary calculations on a reduction of three tapes in tape size for each 1/16 in. rim thickness. In other words, two wheels may be presented to the man who is handling the work. One wheel may be 1 5/16 in. rim thickness, tape 155, and require a 5/16 in. cut in the lathe. The other wheel rim may be 1½ in. thick, tape 166, and require a ½ in. cut in the lathe. Based on three tapes reduction in tape size for each reduction of 1/16 in. in rim thickness will reduce the first wheel 15 tapes, or from tape 155 to tape 140. The other wheel, with 1½ in. rim thickness, tape size 166, and requiring a cut of 8/16 in., will be reduced 24 tapes, or to tape 140. The wheels may therefore be pressed on the axle and placed in the lathe, notwithstanding the difference in rim thickness and tape size, and both wheels will be turned to tape 140.

(An abstract of the discussion which followed the reading of Mr. Knapp's paper will appear in the next issue.)

Automobile Car End Doors Removed*

In 1913 the Kansas City Southern purchased 100 automobile cars, Series 20,500 to 20,599, with large doors in one end of each car to permit the unloading of automobiles from the ends as well as the sides. After the cars were in service a year or more it was found that these large end doors were very expensive to maintain and that little use was made of them, the majority of the automobiles being unloaded and loaded from the large double side doors. It was found that

K. C. S. Automobile Car with New Mogul End in Place of the Original Doors

the end doors could not be kept fastened and frequently hung out over the couplers, violating the end ladder clearance law and continually resulting in safety appliance defects which caused the cars to be sent to the rip track for adjustment. It was also found that a lack of posts and bracing in the ends caused the cars to weave considerably, which damaged the roofs and superstructure.

A design was, therefore, developed to eliminate the doors

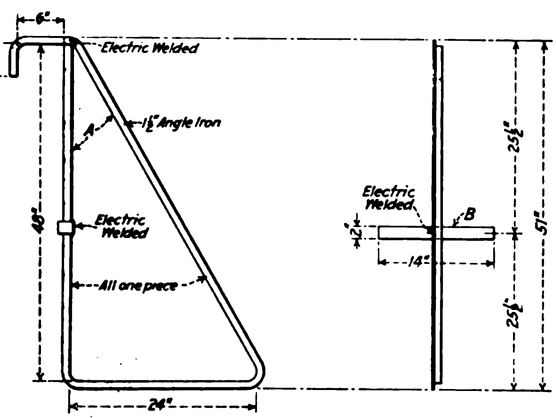
* This article was prepared from data furnished by M. A. Hall, superintendent machinery, and published in the December 15, Mechanical Department Bulletin, of the Kansas City Southern.

and replace them with Mogul ends to both ends of the car and to provide a better roof construction. Thirty of the cars were thus equipped in 1923.

The appearance of these cars in their present condition is shown by the illustration, in which the Mogul end and roof are painted white to show the elimination of the end door and the application of the new roof.

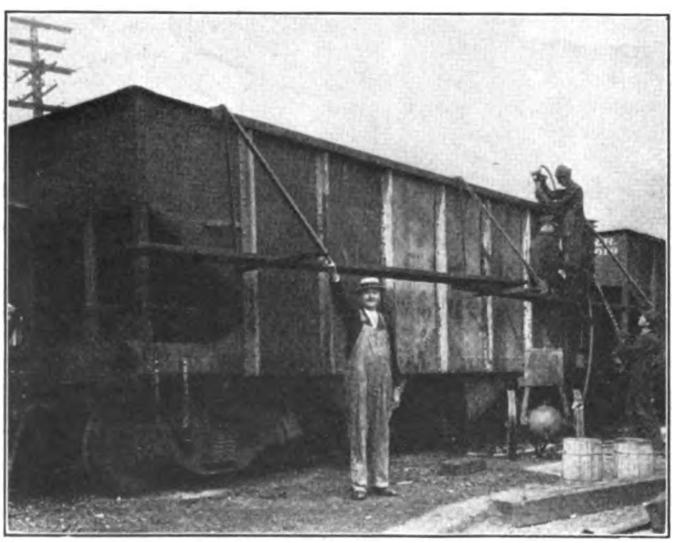
A Platform Bracket for the Steel Car Shop

A DEVICE used for holding a scaffold on the side of a hopper or gondola car, is shown in the sketch. A 1½-in. by ⅛-in. angle, 11 ft. 8 in. long, is bent into the form of a bracket and welded at the top. A cross piece, *B*, 2 in. by ½ in. and 14 in. long, is welded 25½ in. up from the



Bracket for Holding Scaffolding on the Side of a Car

bottom on the vertical side. As shown in the illustration, the ends of the crosspiece are bent in such a manner as to hold the bottom of the bracket away from the side of the car, in order to keep the floor of the scaffold level. Its



The Bracket Permits Sufficient Head-Room for a Man to Work Underneath

light construction makes it easy to move from one car to another and has been found to be a labor saver.

This bracket is intended to displace the wooden horse usually used in a car shop. It is hung over the side of the car and a couple of planks are laid on the horizontal side or bottom leg of the bracket. This arrangement does not take up the floor space formerly occupied by the horses and permits greater freedom of movement in handling material around the cars. The brackets are so designed that the scaffolding can be run the entire length of the car and also allows a clear passage underneath.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car of Light Construction Damaged in Switching Movement

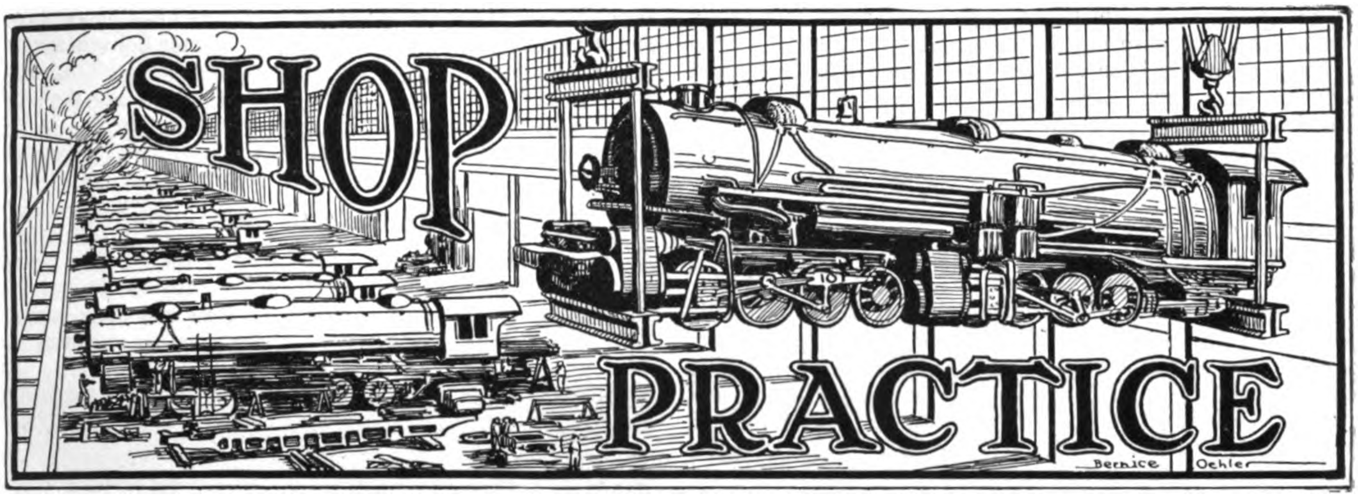
On July 25, 1922, the Fred R. Jones Company's car No. 132 was damaged while being handled in a switching movement at Canton, Ohio. This car, a wooden box car of 50,000 lb. capacity, was one of 30 other cars that were being transferred to the Wheeling & Lake Erie. It was of light construction, and in the attempt to start the train, the sill and draft rigging were pulled out on the *B* end of the car. The Wheeling & Lake Erie made an inspection and found that the damage was due to a decayed end sill, and on account of the light construction and age of the car, which was approximately 30 years old, it could not stand the strain. The owner refused to accept the report of the inspectors and contended that the damage resulting to this car was caused by rough handling on the part of the Wheeling & Lake Erie. It claimed that the handling line should be held responsible as the car was fit for service at the time it was loaded with tools at Canton, Ohio.

The Arbitration Committee rendered the following decision: "The contention of the Wheeling & Lake Erie is sustained."—*Case No.* 1281, *Fred R. Jones Company vs. Wheeling & Lake Erie.*

Another Case Under Rule 32

The Louisiana Railway & Navigation Company's car No. 5530 was damaged while being switched on the lines of the St. Louis-San Francisco. The handling line claimed that this car was being switched on a level grade and under the circumstances, did not require rider protection. Furthermore, its records showed that the speed of the car at the time of the accident was only four or five miles an hour, which, it contended, is the average normal speed for switching service. This car was of wooden construction of 60,000 lb. capacity and was equipped with metal draft arms extending beyond the body bolster. On January 27, 1922, the handling line presented a bill to the owner, of $272.91, claiming that the car was defective and had not been subjected to unfair usage. The owner claimed that rider protection should have been furnished. It also contended that the switchman found a defective brake ratchet on one of the cars being handled with this car and that this charge should have been rendered in conformity with Rule 120, which makes a limit of $270 for the repair of steel underframes.

The Arbitration Committee decided that the car was not subjected to any unfair usage within the intent of Rule 32, and that the owner was responsible.—*Case No.* 1280, *St. Louis-San Francisco, vs. Louisiana Railway & Navigation Company.*



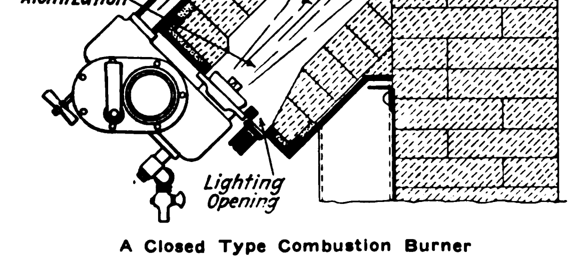
The Correct and Incorrect Use of Fuel Oil*

Marked Economy Effected by Correctly Designed Burners and Furnaces—Quality of Work Improved

By H. A. Anderson
Chief Engineer, Mahr Manufacturing Company

FUEL oil or liquid fuel is one of the fuels most abused because it is so exceedingly easy to build a device that will produce heat. The device may be very inefficient, but by a reckless use of oil, fair results may be obtained.

The term "oil burner" is a misnomer. A great multitude of burners are merely atomizers, spraying the oil into the furnace. The furnace in this case must mix, gasify and burn the fuel. A burner cannot be rightfully called a burner unless it actually completes the combustion of the fuel with out external aid; that is, it must be independent of the furnace.



A Closed Type Combustion Burner

The function of the furnace is not to burn the fuel but to conserve and distribute the heat developed by the burner. The test of a real burner is its ability to completely burn the fuel without being applied to a furnace. To meet these requirements, it must not only atomize the fuel completely, but thoroughly mix the finely divided oil with the correct amount of air. It must then gasify the finely divided particles of oil and completely burn the gas. The gasification and combustion of the finely divided fuel must take place in a small space under high temperature, in order to obtain perfect combustion.

The Four Types of Burners

Liquid fuel burners may be divided into four groups—the vapor, mechanical, spray, and combustion type burner. The vapor burner passes the fuel through or over a hot surface so as to convert the oil to a vapor or dry gas. This vapor is then passed through a nozzle or allowed to escape from the hot surface and mix with atmospheric air. This air is usually induced into the furnace by stack draft. Frequently a small blower is used to aid the stack draft. This type of burner will only operate on the light fuels, such as kerosene, distillate and some grades of furnace oil. Its capacity is limited by the vaporizing capacity of the hot surface over which the fuel passes. It is more or less difficult to control the temperature and atmosphere with this type of burner. The generating surfaces frequently collect carbon owing to the cracking of the fuel. This reduces the capacity of the burner and frequently clogs it up entirely. The field of this burner is limited to small capacities, for small portable torches and domestic heating. The big problem is the control of the temperature of the vaporizing surface and the proper mixing of air and vapor.

The mechanical burner atomizes the fuel by passing it through small orifices under high pressure. These orifices are usually placed tangentially to an expansion chamber so as to set up a rapid rotation. The velocity and rotation atomize the fuel and also help to mix the finely divided oil with the induced air. The air for combustion is drawn into the furnace chamber through small ports around the burner by the effect of the stack or pressure set up in the furnace room. This type of burner is almost exclusively used in the marine service because it requires very little auxiliary equipment. The first object in this service is to reduce the

*A paper presented before the Southern and Southwestern Railway Club at Atlanta, Ga., on September 20, 1923.

weight of the equipment to a minimum, in order to increase the load carrying capacity of the vessel.

The mechanical burner is not well adapted for industrial heating because the operating range is very narrow, but is suited to high capacities, such as 50 gal. per hour and over. A new type of mechanical burner recently developed is the rotating cup atomizer. The oil is fed into the rotating cup by a small stationary tube. The cup is rotated by an electric motor or by a blast of air that passes vanes on the periphery of the cup. This type of burner depends on fan and induced air for combustion.

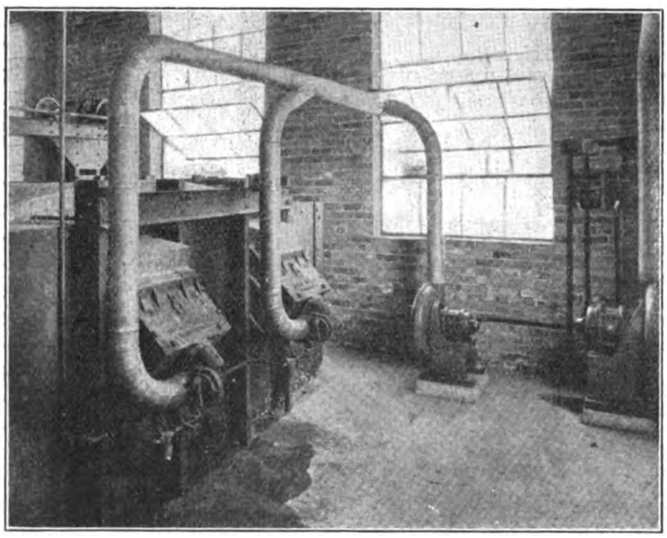
The spray burner is the atomizing device used almost universally in the industries. Atomization is accomplished by passing the oil through a nozzle in the path of a jet of air or steam. The velocity of the air or steam tears up the oil into a spray. This spray or atomized mixture is passed into the furnace for combustion. The velocity of the atomized mixture induces additional atmospheric air for combustion.

Spray type burners may be classed as follows:

1—The high pressure burner that operates on air or steam, usually between 50 and 125 lb. per sq. in.
2—The medium pressure burner that operates on air pressure at from 1 to 15 lb.
3—The low pressure burner that operates on air between 6 and 14 oz. pressure.
4—The high-low pressure burner that atomizes with high pressure air and uses low pressure air for combustion.

The closed type combustion burner operates on low pressure air between 8 and 12 oz. per sq. in. This air atomizes the fuel and also supports combustion, so that there is no induced air variable to contend with in balancing the fuel and air. This type of burner atomizes the fuel over knife edges so located in the jet of air as to thoroughly mix the fuel and air for combustion.

The first stage of combustion is gasification, or partial



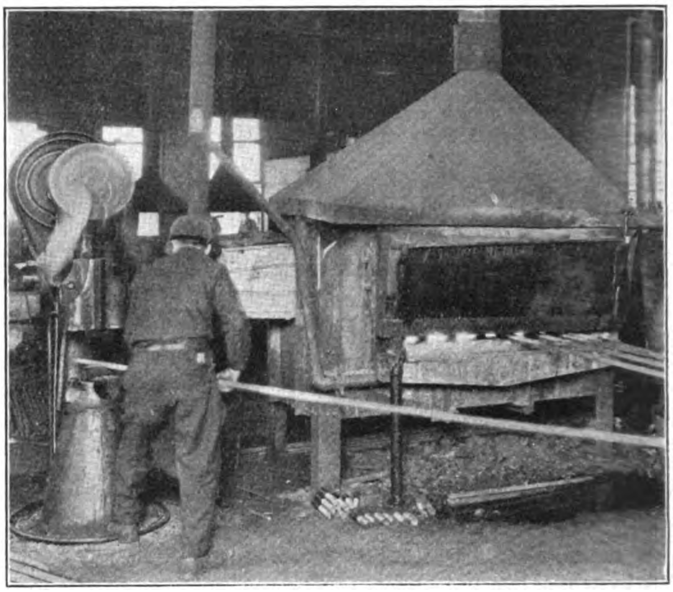
Correct Installation of Low Pressure Blower Piping for Closed Type Combustion Burners

combustion; that is, burning to CO. This takes place under very high temperatures due to the small volume of the combustion chamber. The latter is lined with refractory material which is continually storing up and in turn radiating heat back to the atomized oil for gasification. A secondary supply of air is then fed into the partially burnt gases in such a way as to thoroughly mix, thus completing combustion within the burner.

The combustion type burner makes it possible to burn the fuel with practically no excess air, owing to the thorough mixing and burning of the fuel in a small space under exceedingly high temperatures. All of the fuel and air entering this type of burner is under the control of valves, hence it is easy to obtain the correct balance. The fuel being burned in a relatively small space means high temperatures and perfect combustion. This type of burner delivers a fully expanded, low velocity, hot, neutral gas to the furnace. This supply of low velocity gas readily distributes throughout the furnace. Since the combustion is complete in the burner, hot spots are eliminated in the furnace, thus increasing the life of the refractory lining.

Types of Furnaces for Spray Burners

The ordinary burner, or more properly the atomizer, being only an oil sprayer must depend on the furnace for gasification and combustion of the fuel. There are three general types of furnaces used at the present time to meet this re-



Over-Fired Oil Forging Furnace

quirement. These types are the under-fired furnace; the over-fired, checkered arch furnace, and the side trench-fired furnace.

The under-fired furnace provides a combustion space below the furnace hearth. The burners deliver an atomized mixture to this space with induced air. A flash wall is provided in the path of the atomized mixture for mixing and reducing the velocity to a point where combustion can take place. This space below the furnace hearth must mix, gasify and burn the fuel and then deliver it to the heating chamber above. The high temperatures of combustion under the tile floor of the furnace greatly reduce the life of the tile floor. The floor in this type of furnace frequently fails during operation, dropping the complete charge into the combustion chamber. This large combustion space increases the heat loss of the furnace and also tends to reduce the efficiency of combustion. The rate of heating is comparatively slow due to the large volume of brick that must be heated by the hot gases before reaching the heating chamber above.

There are three methods of venting this type of furnace. The most common system is to place a row of vents in the furnace arch. This system vents the hottest gases from the heating chamber first, thus materially reducing the rate of heating and furnace efficiency. The rate of heating and temperature is not uniform because of a lack of circulation throughout the heating zone. The second method of venting the under-fired furnace is by vent ports in the rear wall. The location of vents in this part of the furnace tends to equalize the temperature in the rear zone of the furnace. The third system provides vents in the rear wall and door. This vent arrangement gives a fairly good circulation of heat with a small, low charge.

The over-fired checkered arch type of furnace provides a combustion space above the heating chamber of the furnace. The atomized mixture is directed against a flash wall for reducing its velocity and further mixing for combustion. The products of combustion fill this space and then escape through the many ports in the arch down to the heating chamber proper. The vents in this type of furnace are placed along the side walls at the furnace floor. The temperature in such a furnace is ordinarily uniform with small, low charges. With heavy charges there is a tendency for the heat to take the path of least resistance and flow direct to the vents, owing to the lack of a forced circulation. The rate of heating is usually slow due to the large amount of brick that must be heated in the combustion chamber above. This, in addition to the larger radiating surface, reduces the efficiency of the furnace.

The trench-fired furnace has the combustion chamber along one side of the furnace. The heat from this chamber is passed over a bridge wall to the heating chamber. The vents are generally located on the opposite side, thus carrying the hot gases over the material to be heated. This type of furnace has the same general characteristics as the under-fired furnace. The temperatures vary considerably from the bridge wall to the opposite side. The areas next to the bridge wall are frequently cold as compared with the vented side. Wide furnaces of this type are sometimes fired from both ends with vents in the arch or rear wall.

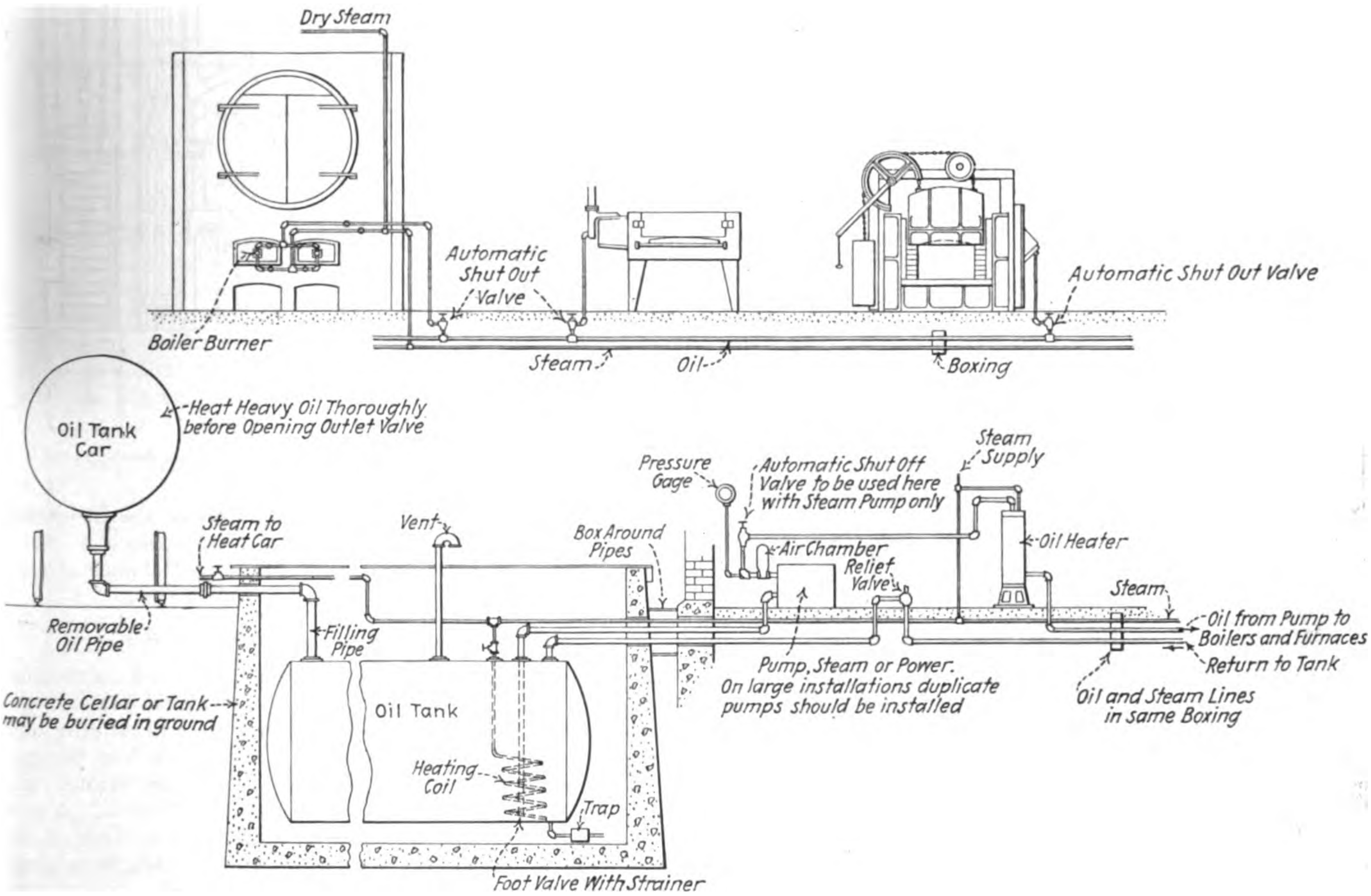
The over-fired, open chamber furnace is recognized by all as the most efficient and fastest heater. Its limitation has been the straight type of atomizing burner which depends on the furnace for combustion. Its disadvantages with the common burner are unequal heating, improper control of temperature and atmosphere, with heavy scaling and pitting of the steel.

The Combustion Type Burner

The combustion type burner has eliminated all of these disadvantages and still maintained the other advantages, such as rapid heating and high efficiency. Such a furnace of the proper design and equipped with a suitable number of combustion type burners will produce exceedingly good temperature uniformity with very close control of temperature and atmosphere. A heat treating furnace, for example, 42 in. wide, 84 in. long with a door 24 in. high will operate within 5 deg. F., plus or minus, in the heating zone. A 6 ft. wide by 14 ft. long by 3 ft. 6 in. high car type annealing furnace with a 12-ton charge will operate within 10 deg. F., plus or minus, in the same plane of the charge.

The combustion type burner is always applied to the upper zone of the furnace chamber with ample space provided above the material heated for circulation and distribution of hot gases. The vents are located close to the furnace floor so as to vent first the coolest gases from the heating chamber. The vent gases are then carried under the tile floor and up through passages in the side walls. Thorough circulation of the hot gases in the furnace with venting of the coolest gases first and then further reducing their temperature by heating the floor gives maximum heating capacity and efficiency.

The life of the furnace lining with this type of furnace is comparatively long as it is only exposed to temperatures slightly above the desired heating temperature. The life of the tile floor in the case of a heat treating furnace will be determined by actual wear of charging and discharging. The refractory lining of the combustion type burner is the only part of the furnace that will burn out and require replacement. With heat treating and annealing the life of this lining varies from one to two years. Where higher furnace temperatures are required, such as forging and welding,



Circulating System of Fuel Oil Distribution

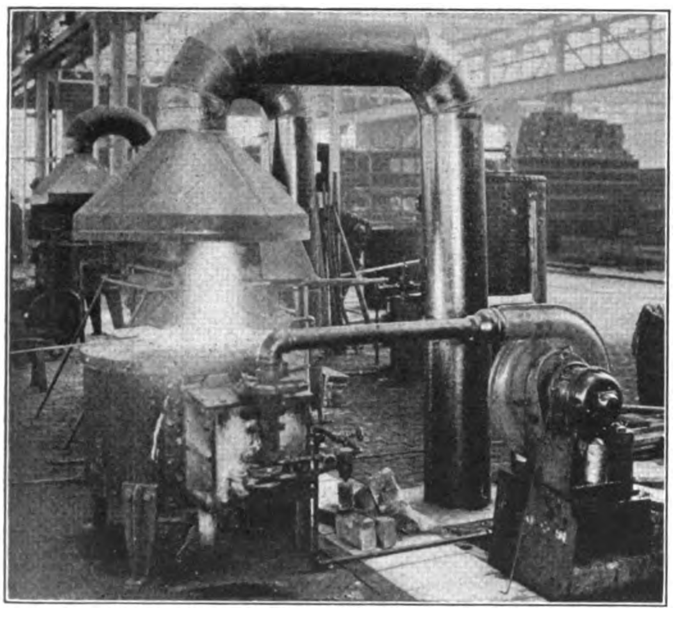
the life is from six months to one year. The combustion burner requires between 30 to 40 fire brick, which is a very small item as compared to the relining of the large combustion space in the other types of furnaces. Tile linings have been developed for the combustion type burner which again reduce the cost of replacing the burner lining.

Forging furnaces are at the present time either over-fired into an open chamber or under-fired in a similar way. The ordinary spray burner is the most commonly used. The nature of forging work is such that scaling, decarbonizing and pitting can be contended with to a certain extent without causing rejections.

Importance of Heating Chamber Design

A combustion type burner applied to a properly designed forging furnace invariably shows big savings in fuel, less rejections, better appearing material, greater output and less cost per hour and per unit produced. The heating chamber must be properly designed in relation to the combustion burner to get the best results. Tests conducted some time ago at Chicago proved this conclusively. An old furnace with high pressure burners was first tested, with an output of 49 lb. of steel per gallon of oil. The furnace design was then changed to conform with the combustion burner design and the old high pressure burner was used, with an output of 62.5 lb. per gallon of oil. The combustion type of burner was then applied with an increase to 72.2 lb. per gallon of oil. In this instance the proper furnace design showed a bigger saving than the application of the combustion type burner.

The refractory material used in the construction of a furnace also affects the efficiency, that is, the amount of

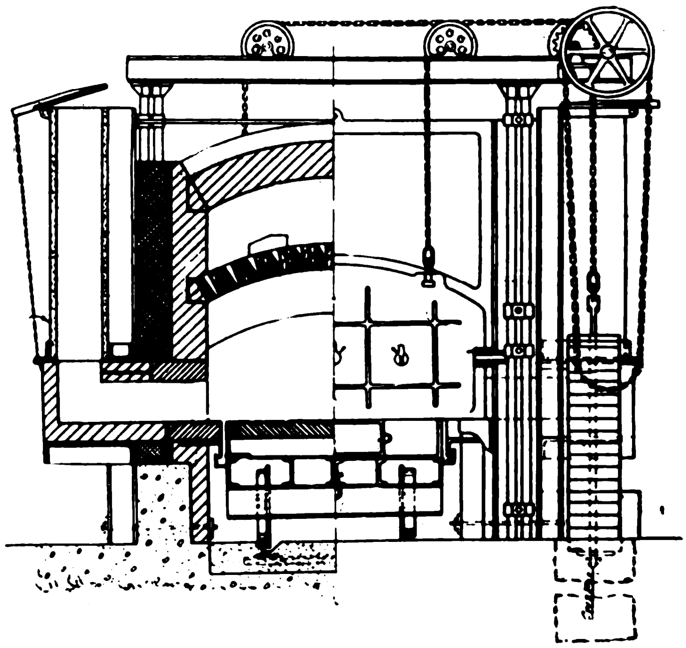


An Oil-Fired Blacksmith Forge

heat lost through the furnace walls. Ordinary fire brick has a certain insulating as well as refractory property. This insulating property is measured in terms of the number of B.t.u. that one square foot of surface one-inch thick will conduct per degree difference in temperature per hour. This unit is known as thermal conductivity. The thermal conductivity of the average fire brick is between 10 and 12. There are other insulating bricks available for further reducing the furnace losses. This brick is not a refractory and, therefore, it must be placed back of the fire brick. The average thermal conductivity of this class of brick is about one; that is, a wall 1 inch thick of insulating brick is equal to about 10 inches of fire brick.

Insulating brick pays the biggest returns on furnaces that are operated continuously. Furnaces used for a few hours each day will show no savings with insulating brick, because the heat would probably only penetrate the fire brick in that period. Therefore, the insulating brick would have no flow of heat to resist. Furnaces used for very high temperatures, such as welding, should not ordinarily be insulated, as the fire brick needs to be exposed to the air for cooling so as to keep it below its melting point.

The color of the surface is also a factor in the heat loss of a furnace. Dark colors, such as black, sometimes radiate



A Car Furnace of the Over-Fired Checkered Arch Type

enough heat to balance the retarding effect of the insulating brick used in the furnace wall. Light colors such as white or light grays radiate very little heat. Light shades of gray are very commonly used for industrial furnaces.

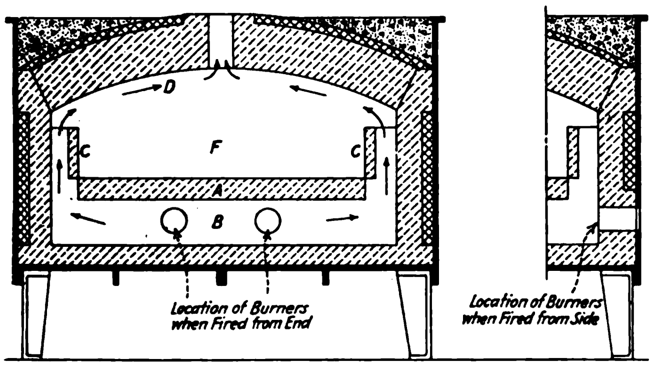
Advantages of Low Pressure Air

Low pressure air which is the atomizing and combustion air in the combustion type burner has several marked advantages over high pressure air. The cost of producing high pressure air is considerably more than that of low pressure air. One horsepower will, under average conditions, produce about five cubic feet of compressed air of 80 lb. A good high pressure burner will induce about 5 cubic feet of free air per cubic feet of compressed air; that is, each horsepower will develop about 30 cubic feet of air available for combustion. One horsepower with a fan type blower will develop about 200 cubic feet at 10 oz. or 6.6 times as much per horsepower. The initial cost of the compressor is many times that of an equivalent low pressure fan blower. The maintenance cost will be exceedingly low with the fan type blower as compared with the compressor. The refractory lining will last much longer with low pressure air as it gives a softer flame with much less velocity; that is, less torch action. The noise of the high pressure burner is a deafening roar as compared with a low hum with the low pressure burner.

The fuel used should be sufficiently fluid to atomize and flow freely. It should be free from dirt and other foreign matter, as this seriously interferes with the proper regulation of the fuel to the burner. The regulation of the fuel at low capacities will be exceedingly difficult unless the oil is clean and properly strained before going through the regulating valve. The clogging of the oil regulating valve throws

the furnace out of balance, reducing furnace temperature and also changing furnace atmosphere.

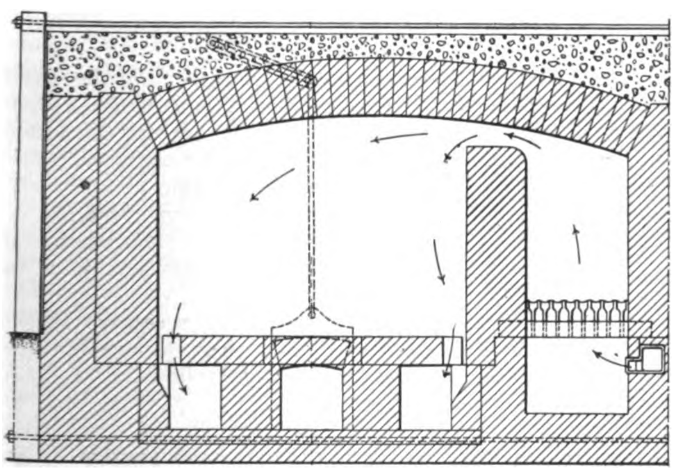
The oil pressure should not be too high. The higher pressure requires less opening of the regulating valve, hence small particles will readily clog it. For average fuel oil a pressure of 30 lb. per square inch is sufficient. If the fuel is heavy, the best way to reduce the viscosity is by a steam heater. The oil may also be heated by running steam pipe lines along with the oil line. The oil line may be passed over the furnace vents with fairly good results. This method does not take care of the starting period, but the oil can be con-



An Under-Fired Furnace

veniently heated for starting by a torch, applying the heat to the oil line and strainer.

It is not good practice to reduce the viscosity of heavy oils by mixing lighter oils, because it is almost impossible to get a thorough mixture. The heavy or thin oil not properly mixed is difficult to control, as a greater amount of thin oil will pass the valve than of the heavier oil. The result will



Example of the Trench-Fired Furnace

be a pulsating flame, causing the furnace temperature and atmosphere to vary.

Oil Feed Systems

There are various methods of feeding the fluid to the burners. The following are the most common methods:

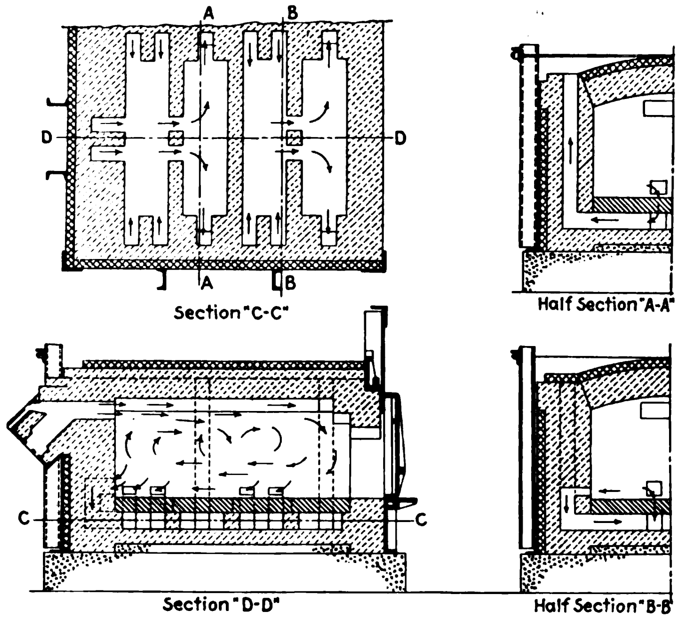
1—Pressure system.
2—Gravity system.
3—Stand pipe system.
4—Circulating system.

The most commonly used system is the pressure or dead end system. Pressure is applied to the tank to force the oil to the various pieces of oil burning equipment. It is usually difficult to handle heavy fuels with this method because the heavy congealed oil in the pipe lines must be forced through the burners in starting at a time when the oil should be at its best. Dirt and sediment have a great tendency to collect in the pipe lines in this system due to the small flow of oil. Pressure on the fuel tank is also a decided fire hazard.

The gravity system is used in many small plants where only a few pieces of oil burning equipment are operated. This system does not work satisfactorily with the heavier fuel oil due to the resistance in the pipe lines. It has about the same disadvantages as the pressure system.

The stand pipe system with an over-flow is very similar to the ordinary gravity system. The fuel is pumped to the stand pipe and maintained at a constant pressure head by an over-flow opening. The fuel is fed to the various furnaces from the lower portion of the stand pipe.

The best system for handling liquid fuels is the circulating system where a rotary or reciprocating oil pump is used to circulate the fuel through a pipe passing all the oil burning equipment and then back to the tank through a relief valve. The relief valve can be set to maintain any desired



The Over-Fired Open Chamber Furnace

pressure in the circulating system. Branch lines to each burner are tapped in on the main circulating pipe. Automatic shut-off valves can be installed on each branch line for its protection.

The moment the oil pump is started with this system the congealed oil in the main pipe is returned to the tank. The circulation of the oil has a great tendency to reduce the viscosity of the oil and also to thoroughly mix it. The starting of an oil burner merely reduces the amount of oil returned to the tank. The flow of oil is free from pulsations when the system is equipped with a rotary oil pump. If a reciprocating pump is used, an air chamber should be provided to reduce the pulsation to a minimum.

Savings Effected by Scientifically Designed Equipment

A test was recently conducted in a plant making stay-bolts. The test was for the purpose of determining whether it would be advisable to install modern furnace equipment or to continue with the old equipment. The furnace chosen as representative was a 42-in. by 12-in. by 3-in. under-fired forging furnace. It was equipped with three low pressure inducing type burners. This furnace turned out 5.88 lb. of iron per pound of oil, or 46.7 gallons per ton of metal heated.

The new furnace was a 42-in. by 13½-in. by 2½-in. over-

fired forging furnace equipped with one combustion type burner. This furnace produced 10.05 lb. of iron per pound of oil, or 26.4 gallons per ton of metal heated. The saving in fuel was 43½ per cent. The material heated was free from scale with no traces of pitting. The heavy scaling and pitting of the old furnace had been the source of considerable rejections and other trouble.

An eight-ton car type annealing furnace designed for combustion type burners was recently installed in one of the steel foundries on the Pacific coast. The oil consumption per ton of castings annealed was checked over a period of several months; the average was 13.65 gal. per ton. The average cost of fuel oil during that period was 5.6 cent per gallon which gave an average cost of annealing steel casting of 78 cents per ton.

A neighboring concern had some time before built its own car type annealing furnace and applied high pressure burners. These showed figures as high as 70 gallons per ton of steel castings annealed, or a cost of $4.25 per ton. This company has recently installed a 12-ton electric furnace for the purpose of reducing its annealing cost and increasing the quality of the castings. With this furnace, however, the cost per ton of steel annealed jumped to $7.50 per ton.

A steel foundry in Ohio recently equipped its $20,000 electric car type annealing furnace with two combustion type burners. These effected a saving of $3.50 per ton over the cost of heating the furnace with the electric power. This furnace, although not properly designed for combustion type burners, consumed only 18 gal. of fuel per ton of steel annealed.

Comparative tests were made between the high pressure rivet forge and the low pressure over-fired combustion type rivet forge on one of the large eastern railroads. The total cost of operating each forge, including fuel and air at a capacity of 720 ¾-in. by 3-in. rivets per hour, was checked very closely. The high pressure rivet forge cost 38.44 cents per hour to operate. The over-fired, combustion type rivet forges operated at a cost of 21.16 cents per hour, or a saving of 46 per cent. There were also other savings, such as less burnt rivets, cleaner rivets, less rejections, softer rivets and less heat radiated from the forge, making the working conditions more favorable.

Maximum production per man, per furnace, per unit of fuel with uniform high quality can only be obtained with a scientifically designed furnace, heated with a correctly designed combustion type burner.

"A Level Head and a Feeling Heart"

These Are Requisites of a Successful Leader; Impersonal Relationship Must Be Replaced

By A. Montangie
Civil Engineer (Mechanical Department), Belgian State Railways, Ghent, Belgium

SUCCESSFUL shop management is a technical, social and psychological problem. We shall limit ourselves in this discussion to the latter part in which the relation of men and management are considered—what they should be and how to realize them. The efficiency of a gang, shop, factory or other industrial community depends upon the co-operation of its elements: Man, foreman, manager or leader.

The Man

The mind of a man, taken as a unit of a group or as an individual, is not the same. This psychological truism, well known by political and trade union leaders, is often ignored by the real leaders of men of our industrial communities—the managers. As an individual, the average man is open to reason, and apt to grasp the facts of a case; intelligence leads him; as a unit of a group he is more often open only to feelings receptive to speech—to words, however false, cleverly and enthusiastically repeated—but is entirely closed to reason. He is governed by his feelings. Hence to promote his efficiency, foster the first feeling, guide the second.

The man should have the consciousness of his responsibility, feel that as an individual he is a useful and necessary unit, that his work is worth doing, useful to him first, but to others as well. The pride of trade will follow; also the desire of knowledge of his trade.

The character of the industrial worker—the one engaged in railroading in particular—should be built up of the above named requisites: Feeling of responsibility, pride, knowledge.

How is this usually promoted? Through a system of apprenticeship, steady employment, educational facilities for all hands and all ages. But these consider only the social side of the question; the psychological side is ignored or neglected. The former fosters ambition, but not confidence and personal pride. So long the man is not aware that instead of being a mere money-making machine, he is a necessary, useful unit in which his equals and superiors are interested, and whose interests coincide with his own, the psychological side of the question may be considered as ignored.

Loyalty, enthusiasm and confidence are necessary factors to the efficient operation of any gang. How to acquire these valuable assets is demonstrated by what follows.

Foreman

The link between the men and the management is the foreman. Coming usually from the ranks the foreman possesses the qualities and mind of the man. He should have something more—the qualities, at least part of them, of the manager or leader.

Master of his craft he must be; his subordinates must rely upon him and obey his orders, but above all, he must be a leader, know individually the men of his gang, be ever present among them. His authority is based on the knowledge of his men, character and professional ability. To grasp the mind of an individual is not an easy task. How to issue an order, supervise its execution, correct a mistake, will vary with each unit. The intelligent, active fellow will not want many explanations as to how a job is done, but will want to know why it's done. The less intelligent, lax worker wants the reverse.

What about the much asked question "How many men should a foreman supervise?" Precise figures cannot be given; too many factors vary—the job, size and facilities of

*Submitted in the Shop Management Competition, which closed September 23, 1923.

shops, dispersion of men, quality of the men. Compare a boiler repair shop with a car repair shop, or a track gang. In the first case, 12 to 20 is about what the foreman can manage. Twenty-five to 30 is a good average for the second, as much as 50 for the third. The real number is to be gaged by the value of the foreman.

The foreman's pride of enjoying the confidence of his men through continual intercourse must be supplemented by the pride of enjoying the confidence of his manager. A dissatisfied foreman usually results in an indifferent crew. A manager should not only issue orders, he should explain them, show his foremen the "why" of things, their use in the economy of the shop; lead him, advise him in reading matters pertaining to his trade, foster the creation of clubs, let him come in contact with other roads and get acquainted with other trades.

Specialization is nowadays a necessity, which is apt to make one too one-sided. A leader should broaden his foreman's mind. The watertight bulkheads between the different departments should be removed, which brings us to the point—What should the manager be?

Manager

Usually a manager (head of a department) of any branch of a railroad is a very busy fellow; much of his time is taken up by clerical duties and office work, and the very little, if any, that is left is available for a hurried trip to part of the works he has the control of. This intercourse with his foremen is limited to a few minutes devoted to acquaint them with his orders—with his men: nil, and often all orders are issued on paper.

It may seem a big proposition for a manager to know personally a dozen or more foremen and several hundred men of various callings. Is it possible? At first sight, no. But let us look into the question further.

What is necessary is not so much that the manager should know each of his subordinates by his christian name, but that each of his men should know him, not as an entity hidden in a far-away office, but as a member—the first—of their community.

A manager, be he a college man or not, is often a man with a broader and more refined education, and although a man is a man, his superior intelligence gives him a higher standing. His presence among his subordinates will secure him their confidence, and prove to the men that he is interested in their work and welfare. A good word, a simple question, a little advice will do a lot more towards good understanding than a set of meetings, speeches and recommendations.

A couple of hours a day away from the office and devoted to the shops will do wonders. A foreman does not like to travel to a far-away office for an inquiry, but give him the opportunity of interviewing you at the place of his work. Instead of perusing lengthy reports indifferently made up, ask him what you want to know. You will get your information better and quicker. Acquaint the foreman with your views, your reasons for ordering this and that, the goal you have in view, etc. A stop of a few minutes between your machine tools will wonderfully accelerate the r.p.m. of many a machine tool when the operator feels you are interested in him. Many an improvement has been suggested in this way. Spend a day off driving one of your engines. Explain to the driver why to spare coal and oil, why to keep the engine clean, and discuss any other topic in which he is interested. Examine the records a few months later, and the results are often astonishing. You may consider it los time. It is not; dollars and cents may promote steady and good work but not enthusiasm that makes a man proud of his trade, of his shop and of his "boss." Lead a shop or a gang with a level head, but also with a feeling heart. The men will respond better to the second than to the first.

The problem of efficiency—the human factor alone considered—is to be solved by the intercourse and mutual understanding of leader and men. Put yourself as manager in the man's stead. You can't put much faith in and support enthusiastically such nebulous deities as an "administration," "board," "railroad," etc., of which you know no more about than of the old gods of antiquity or the "Great Loma"; but you will feel proud to be appreciated and connected with the "big man" and give him your unreserved support.

A secondary result will be that your hold over your men will counterbalance the influence of outsiders, trade union leaders and politicians, and will strengthen the authority of the rightful leaders of men—your foremen. Of course, the same applies to higher spheres. The basic principle is: Replace the actual impersonal relation between elements by personal knowledge of each other.

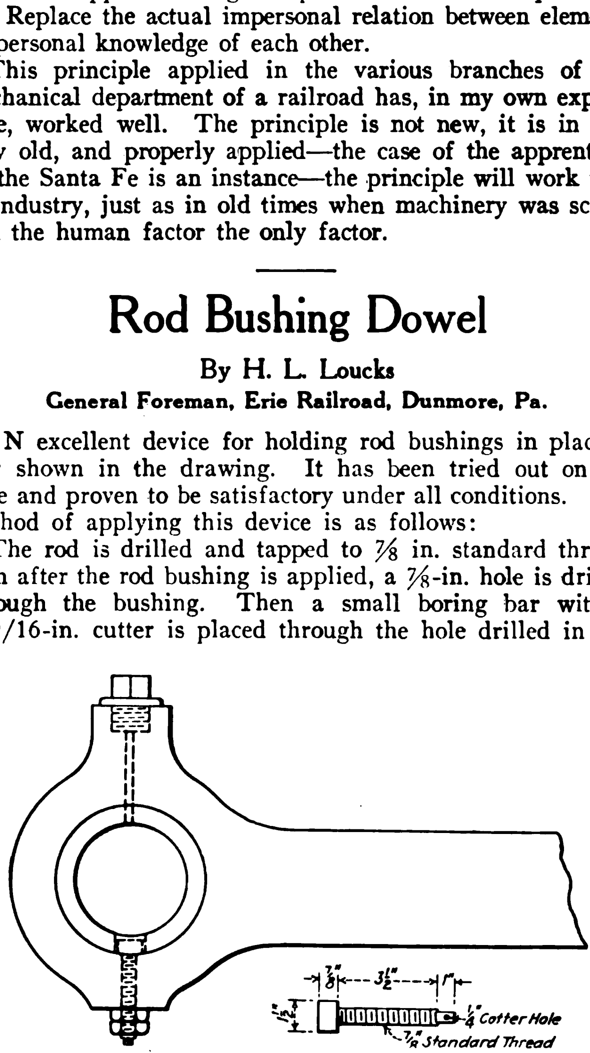
This principle applied in the various branches of the mechanical department of a railroad has, in my own experience, worked well. The principle is not new, it is in fact very old, and properly applied—the case of the apprentices on the Santa Fe is an instance—the principle will work well in industry, just as in old times when machinery was scarce and the human factor the only factor.

Rod Bushing Dowel

By H. L. Loucks
General Foreman, Erie Railroad, Dunmore, Pa.

An excellent device for holding rod bushings in place is shown in the drawing. It has been tried out on the Erie and proven to be satisfactory under all conditions. The method of applying this device is as follows:

The rod is drilled and tapped to 7/8 in. standard thread, then after the rod bushing is applied, a 7/8-in. hole is drilled through the bushing. Then a small boring bar with a 1 9/16-in. cutter is placed through the hole drilled in rod



Method of Applying Dowel for Holding Bushing in the Side Rod

and the spindle of the machine is fed upward until the cutter strikes the steel part of the rod.

The rod dowel is then screwed in from the inside and two faced nuts and a cotter applied. This arrangement prevents the dowel from working loose as well as turning of the bushing in the rod. It is practically impossible for the bushing to get loose. When it is desired to remove the bushing for renewal, it is only necessary to remove the dowel and then take out the bushing in the usual manner. In case shims are to be applied, the bushing is given a one-quarter turn in the rod, and then drilled and counterbored as before.

Examples can be given where a set of rod dowels have lasted five or six years and on account of their long wearing qualities, it has not been found necessary to keep a large stock of dowels on hand.

Welding Standardization in Locomotive Shops

A Review of the Various Methods Used on Boilers, Fireboxes and Running Gear

By James S. Heaton

Welding Supervisor, Wabash, Decatur, Ill.

THE development of welding in locomotive repairs has been exceedingly rapid during the last few years. A few large railroads have employed experts to supervise the work, who report directly to the superintendent of motive power. It is the expert's business to make the practice of welding uniform in all the shops of the system so that the failure of one shop to get results can be traced to its origin. The supervisor of welding must find a successful method of performing each operation and require each shop to work according to his instructions. The standardization of welding is simple under such direction. It is more difficult to standardize on, roads that do not employ a supervisor, but the necessity is even greater.

Keeping of Proper Records

Records should be kept of each particular welding job on a locomotive and should be filed for future reference. For example, on boiler work a form, shown in Fig. 1, showing the side, crown, door, flues and wrapper sheets should be used to show the repairs made and seams that were welded, together with the date, name of the operator and name of the shop. A form showing the different frames, Fig. 2, should also be used to show the weld and the method used in welding. Similar reports should be made of welded tires and cylinders as shown in Figs. 3, 4 and 5. Three copies of these reports are filled out, one to be forwarded to the superintendent of motive power, one to the supervisor of welding and one to be kept by the shop doing the work. For back shop work a form similar to the locomotive report should be used to show all the parts welded while the engine was in the shop. A careful check should be made at different times to ascertain the wear and condition of the welds and if any job does not come up to expectations, a satisfactory method should be found.

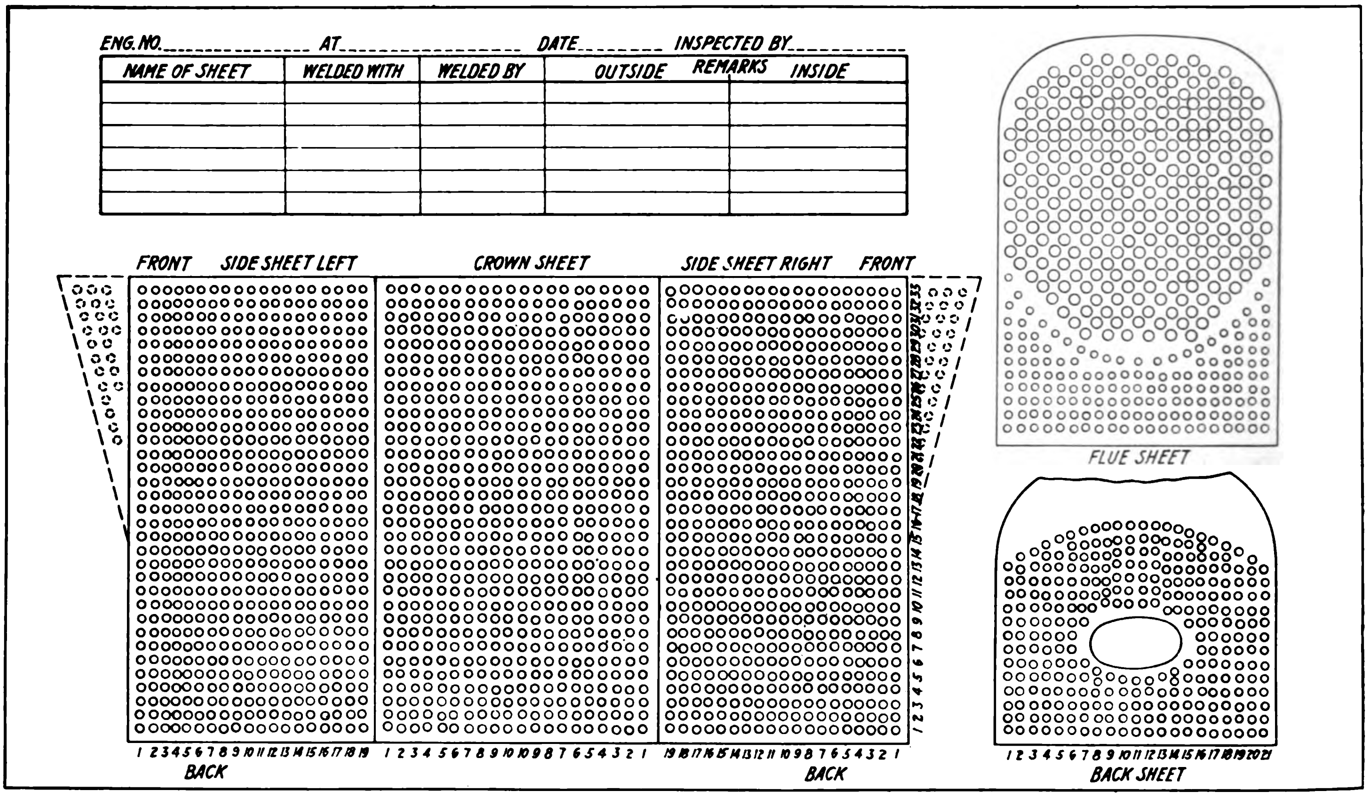


Fig. 1—Form for Reporting Boiler Work

Standardization of Equipment

The supervisor of welding should be held responsible for the output and upkeep of all welding equipment. He should be allowed to select the equipment that he deems necessary to give the required output. All equipment, as well as the method of welding, should be standardized. This is necessary for two reasons: First, that repair parts be on hand at all times; second, that after teaching an operator one machine, he can work on any of them without further instruction. Some machines will give a greater output than others, while some will produce better work than others.

The supervisor of welding must be familiar with all makes of machines and competent to select the best suitable for the work. There are so many different kinds of wire, brass rods, cast iron rods, fluxes and other necessary supplies on the market today that it requires some one familiar with welding work to be able to select the best materials. The best obtainable is the cheapest and the supervisor should be on the lookout at all times for better materials.

As the repairs to welding equipment are of a delicate and exact nature, it requires an expert workman to perform such work. There should be a centralized repair shop to take care of the entire system. All torches and regulators should be forwarded to this shop for repairs when necessary. It has proved to be more economical to have enough equipment on hand to allow an extra set to be at the shop at all times, than to require the use of a faulty outfit, which is not only dangerous to the operator, but to others around him.

Layout of a Welding Shop

A welding shop should be laid out so that work may come in at one end and go out at the other. An enclosure of curtains, or a wall to keep the sand from flying over the machinery, should be erected for cleaning all material before it reaches the welder. A sand blast is best suited for this work. An enclosure should also be erected for chipping to prevent chips from flying. A preheating furnace served with

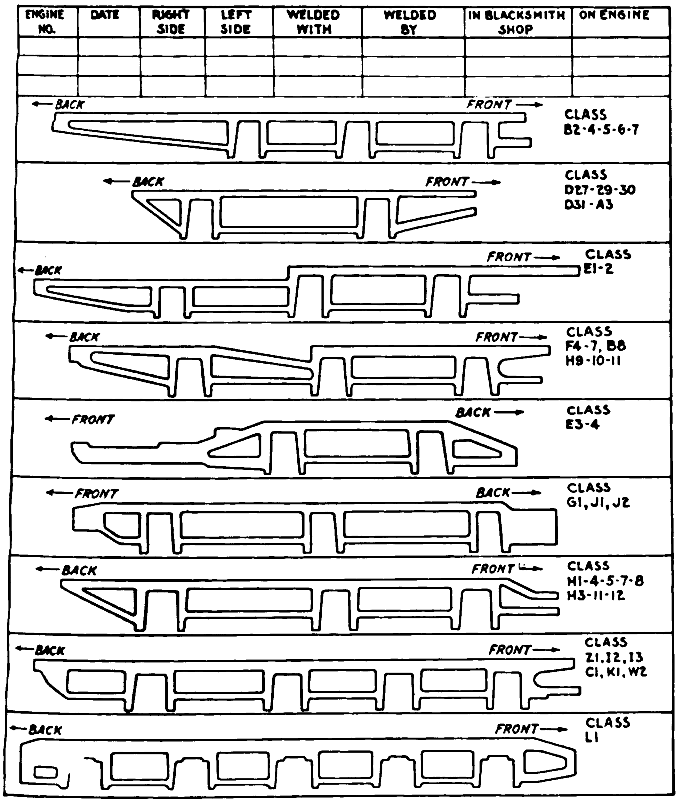


Fig. 2—Form Used for Reporting Welding Work on Frames

a swinging air hoist and provided with a cast-iron slab high enough for a welder to work at comfortably should be placed adjoining the enclosure and next should be an open forge so constructed that it will accommodate three separate fires. A swinging air hoist that will handle all the heavy work from the cleaning rooms to the welder and on through the shop is an excellent aid in expediting the work. More work can be turned out if the proper facilities are installed to help the welder instead of ruining his temper and perhaps cause injury to him by lifting hot and heavy castings.

A stationary machine should be installed at any point in the shop, such as the valve, rod, tank, or driving box area, where there is sufficient work to keep a welder busy. This will eliminate the transporting of material to and from the welding shop and also save the time consumed in waiting for a traveling crane.

The Traveling Work Shop

One of the most useful equipments that a railroad can operate is a traveling work shop. This shop is equipped with a gasoline-driven electric welding machine, a gasoline-driven air compressor, an acetylene welding and cutting outfit, a small lathe, drill press and emery wheel. Tools capable of taking care of stationary boiler work can also be included. This work shop, operating over the entire system, can make repairs to stationary boilers at pumping stations and depots and to switches, frogs, bridges, pipe lines, etc., eliminating the cost of tearing down and replacing material that can be repaired cheaply where it is installed.

Proper Welding Instruction

In making preparations for a weld, the following must be given consideration: Condition of surfaces, bevel of material, position of material, provision for expansion and contraction, use of proper filler material and allowance of sufficient room for the welder to work.

Failure to observe any of the above considerations will tend to make a bad weld. All surfaces must be free and clean from foreign substance, such as dirt, scale and grease. Welding on a dirty surface will make a seamy and faulty weld. All boiler sheets, patches, frames and other material that is broken must be beveled to 45 deg. on each edge, leaving an opening at the underside of 1/8 in. to be sure that the weld will be made through the entire piece. The proper filler rods to be used for each operation should be noted in the instructions. It is important that the welder be allowed enough room to work. His work is tedious and if placed in such a position that he is under strain, the result is apt to be faulty. All of these precautions should be taken to assist in caring for expansion and contraction. Sheets and patches that are applied on a straight line must be corrugated along the line of welding. Smaller patches should be cut either in diamond or oblong shapes.

Each foreman and welder who follows instructions will find his work more satisfactory and more easily understood. As his experience widens, he will doubtless submit suggestions for improvements and better methods. These should be carefully considered and if a better way is suggested, it can be adopted in place of any practice then in force. However, changes should be submitted to the supervisor of welding, who should always issue the instructions authorizing any change.

Welding of cast iron, brass, cast steel, forgings and all heavy work that is done by the acetylene process must be preheated before welding. This is done to save gas and the welding will begin almost immediately after the torch is applied. As the acetylene operation is very costly, it can readily be seen that the heating of the heavy parts will eliminate a great deal of this cost. The preheating of cast iron, brass and other heavy castings is not only necessary for the saving of gas and time, but is also necessary in many cases to take proper care of expansion and contraction.

Acetylene is dangerous if not handled carefully and extra precautions should be taken to eliminate personal injury and also possible damage to railroad property. All equipment that is in need of repairs should be taken at once to the tool room. Operators should have all parts of the body covered and well protected. They should not attempt to weld without using the proper glass to shield the eyes. All welding operations should be screened from other workmen. Insulation of all wires should be kept dry and in good condition.

Instructions for Welding Boilers

For purposes of standardization, the following rules have been drawn up to cover work on boilers:

1. Welding will not be permitted on any part of a boiler that is wholly or in part in tension.

2. Staybolts or crown stays must not be built up or welded to the sheets.

3. Holes which are larger than 1½ in. in diameter, when

entirely closed by welding, must be properly stayed.

4. Only competent operators will be allowed to weld on boilers.

5. All parts must be clean before starting and must be kept so during the welding.

6. When repairing fireboxes a number of small patches should be avoided and full sheets applied.

7. Never cut through an old weld to apply a new patch.

If a cutting torch has been used to bevel a sheet, a chipping hammer should be used to remove all the burnt metal caused by the torch. The back-step method should be used in all boiler welding. This insures better expansion of the sheets than the old method of continuous welding. On calking edges and seams the welding should extend on the under sheet the same thickness as on the top sheet. By this method the seam will present a sloping edge to the heat, thereby eliminating fire cracks in the top plate at the rivets.

When welding jacket studs on a boiler head, the stud should be beveled on one end and the place to be welded on the boiler cleaned off. Then hold the stud in one hand and tack it to the boiler and weld completely around it. This eliminates drilling out the broken stud and tapping and renewing for a new stud. Care must be taken not to weld over the old stud as it is liable to leak. This method can be used for welding studs for oil pipes on the boiler, as well as sand pipe clamps and studs to the frames.

Welding Work on Fireboxes

When it is desired to weld a firebox without removing the back end, the welding edge should be prepared the same as on boiler sheets. Then bolt the sheet securely in place, taking care that there is a uniform opening of 1/8 in. all around the welding edge. Drill 1/2-in. holes, spaced about 14 in. apart, and use two pieces of 1/2-in. by 2-in. by 4-in. boiler plate on both sides of the sheet. Clamp with 1/2-in. machine bolts, being sure that all bolts are drawn tight. Rivet the top of the flue sheet to a point not less than 12 in. below the center of the crown, then start welding by using the back-step method, moving the clamps when necessary. Next weld the entire door sheet. All welding on riveted lap seams in a firebox should be applied to cover the entire edge of the sheet and should extend on the under sheet a width equal to the thickness of the top sheet.

In welding around the door, cut outside of the first row of staybolts and trim the outside edge of the sheet just inside of the rivet holes. Bevel all edges 45 deg. and fasten the patch in place, using the same method as for side sheets. Remove the row of staybolts adjacent to the patch and use a sand-blast to clean the edges. Weld by the back-step method.

In renewing the upper part of the door sheet, cut out a patch allowing enough metal so that the line of the weld will come below the second or third row of staybolts. This will take care of contraction. Have all edges beveled to 45 deg. and use a sand-blast to clean the edges. Butt weld to the crown and side sheets. The sheets should be held in position by the same method as used for the side sheets. Weld by the back-step method.

In welding the side sheets, cut the sheet 12 in. below the crown sheet. Remove all staybolts and rivets and also the adjacent row of staybolts in the upper sheet. Cut the door and flue sheet inside of the rivet holes and bevel each to 45 deg. Place the sheet in position, using bolts in the mud-ring 1/16 in. smaller than the holes, and bolts in the top of the sheet with staybolts screwed in from the outside to force the sheet against the bolts to hold the sheet in position. Sand blast the edges and weld the sheet at the top first, using the back-step method, then weld the door and flue sheet. Remove all bolts and rivets before the weld cools.

Where possible, all side sheet patches should be cut either in diamond or oblong shape. Never allow more than 8 in. in the vertical seam. When applying such patches, allow sufficient bolts to hold the sheet in position with staybolts screwed in from the outside to force against the bolts. Remove the adjacent row of staybolts in the sheet. Clean the edges by a sand blast and weld by the back-step method, using a mild steel electrode. Remove the bolts and staybolts before the weld cools.

For all leaky seams that are beyond calking, remove the rivets and cut the outer sheet on a line with the center of the holes. Bevel the sheet to 45 deg., sand blast the edges and lap weld, filling the holes in the under sheet. This eliminates the renewing of a sheet that has worn edges.

If a wrapper sheet is wheel worn 40 per cent. or less, the worn place can be replaced by welding. Remove all staybolts in the section to be welded and clean off by using the sand blast. Then weld to the original thickness. Care should be taken to weld around all staybolt holes so they can be tapped out to full thread.

Flue Sheets

For the front flue sheet, the welder should use a cutting torch and cut the sheet at the knuckle. If the top of the sheet is in good condition, cut just above the top row of flue holes. If it is not in good condition, then cut out the entire sheet and bevel the edges to 45 deg. Place in position by using a strong back and tack weld around the sheet at points about 12 in. apart. Sand blast the edges and weld by the back-step method, using a mild steel electrode as in previous operations.

In welding broken flue sheet bridges, it is best to cut the crack to 90 deg. and have a 1/8-in. opening at the bottom. Clean off with a sand blast and drive an expander in the flue hole. Drive the expander out before the weld cools.

For a three-quarter sheet cut between the top of the staybolts and throat sheet braces and remove the top row of staybolts. If the crown and side sheets are in good condition, the flue sheet may be riveted. If not, then cut off behind the rivet holes and prepare the same as for welding a door sheet. Weld by the back-step method.

For a whole sheet, if it is in good condition at the mud-ring, cut between the bottom row of staybolts and the mud-ring. This saves time and the expense of removing the mud-ring rivets. Weld in the same manner as for a three-quarter sheet.

For a crack in the back flue sheet knuckle, bevel out the crack to 90 deg. from the water side, if possible. Sand blast the edges and weld by the back-step method, using a mild steel electrode. The weld should be reinforced 1/8 in. on the fire side.

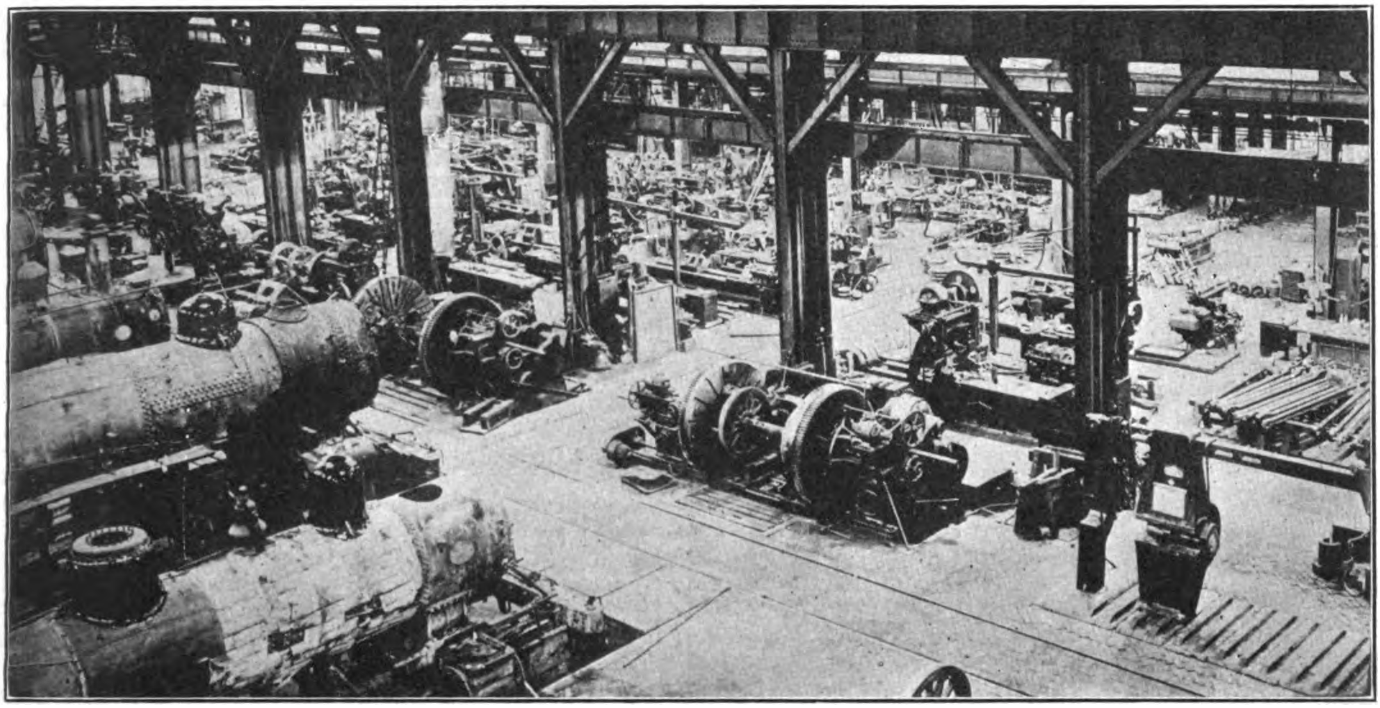
In welding flues, have the sheet and flue beads cleaned off completely with the sand blast, begin welding at the bottom center of the flue and finish at the top center. Never weld down on the side of a flue. Start welding at the top of the flue sheet and then finish each succeeding row before starting on the next. This will keep the heat down.

Repairing Mud-Rings

For a mud-ring patch cut out all defective parts and remove the first row of staybolts adjacent to the cut. Bevel the edges of the sheet and patch and place the patch in position, using bolts 1/16 in. smaller than the rivet holes in the mud-ring. Use the sand blast to clean and weld by the back-step method.

To prepare for the welding of a broken mud-ring remove enough from the bottom of the fire box plates to permit free movement of the welding tools. Vee out the mud ring to 45 deg. on the top side of the crack, leaving a 1/8-in. opening at the bottom and force open the fracture by driving in a small wedge. This will take care of expansion. Clean off with a sand blast and weld.

(To be concluded next month.)



A Few Points for Erecting Shop Men*

Practical Suggestions Leading to Smooth Operation, Greater Efficiency and Improved Working Conditions

By William Hall

Erecting Foreman, Chicago & North Western, Winona, Minn.

SOME of the larger shops have separate stalls for stripping the engines. This is desirable in either a large or small shop for then the erecting pits and surroundings can be kept cleaner, no lost motion or loss of time is experienced while waiting for the wheeling or unwheeling of the engines and the removal of the parts stripped, and it makes for efficiency. In shops where separate stalls are not used for stripping, no engine should be permitted to enter the shop without first having the pits cleared of all dirt and debris from the engine last occupying it, thus giving the men assigned to that pit a clean place to work in and around instead of one littered up with all kinds of junk—nothing is so conducive to any man's happiness and efficiency as cleanliness.

Ash pans and fireboxes should be thoroughly cleaned before the engine enters the shop. Such work should always be done over the cinder pit before crossing the turntable as this saves time and the shop drainage is not blocked up. Time and again I have seen an engine placed over the erecting pit with the ash pan filled with cinders and a great bunch of unburned coal in the firebox which is dumped into the pit, thrown out again, loaded into wheelbarrows and carted away to the ash pile. Again I have seen engines hauled dead from outlying points in this condition, whereas all this should have been left at the starting point.

A good routing schedule is a wonderful help to the erecting foreman, providing it is efficient and lived up to in every department for then he can figure accordingly. Foremen's meetings may help some but the better way, in my estimation, is to get each foreman into the office separately and go over his part of the various operations. You can then get his own true opinion of what is delaying him if delays occur.

Importance of Special Gangs

Specializing the work is an excellent assistance for the erecting foreman. For instance, special men for hanging guides, preparing and laying out shoes and wedges, special men on steam chests and rocker boxes, and so on all through it works out to advantage for obvious reasons.

I first conceived the idea of specializing the work of the erecting department when I was an erecting foreman in one of the largest locomotive repair shops in Chicago. It was started in a small way first, then finally the whole shop was specialized. I worked the men into it gradually, being careful not to give out the idea of what my purpose was, but it worked out well and met with the approval of the men.

There is very little work in the erecting department that can not be specialized. I had men whose work it was to fit pedestal binders, file jaws and lay out shoes and wedges. When done with the first engine out, they would move to the second engine out, as the list showed. Another gang would hang the guides, ream the bolt holes, put in the pistons and cylinder heads; another would be assigned all cab work; another reverse gear and throttle lever and quadrants; the next, eccentrics, straps and blades and hanging links; another gang would take the brake rigging, and so on throughout the whole locomotive. The number of men in each gang and the number of gangs would depend largely upon the size of the shop. That would be easy to determine.

There is no difficulty whatever in training and developing

*A paper submitted in the Erecting Shop Competition.

the men for the various classes of work. Care should be taken, however, in the selection of the men to start with as some may be more adapted for one particular work than another. That more can be accomplished by this method goes without saying as each gang would have the necessary tools and would see to it that its special work was made as easy for themselves as possible. Take the guide gang for instance. In order to help themselves, they would have bolts in the rough in stock, guide liners of various sizes would be gotten out in quantities instead of just as required when the work is distributed indiscriminately.

In many shops the work of the erecting foreman is retarded by the boilermakers. In my opinion only small jobs should be performed by the boilermaker in the erecting department as the machinists in that department cannot work to advantage and are delayed considerably when the boilermakers are around. It is not only an inefficient way of working, but is not conducive to safety first. It is claimed that time is saved by doing some big jobs on the erecting floor without taking the boiler to the boiler shop, but my 40 years' experience tells me a different story.

Value of a Clean and Orderly Shop

The bunching up of engines on one pit is a deplorable condition and retards efficient working of the erecting department. I have seen as many as four heavy engines stripped on one pit—I do not here refer to the stripping pit. Anyone can imagine what a jumbled up mess it is when parts of several engines are left around, as is often the case. The condition is exaggerated when the engine is stripped for the boiler shop. Such a situation, however, can be avoided if before stripping the second or third engine the parts of the first are loaded and set away till wanted. The loss of time in sorting out the parts required would not only be in the interest of economy of time and material, but in line with safety, as men would not be tumbling over parts and injuring themselves. Again, in my opinion, engines should be washed off thoroughly outside and underneath before entering the shop. The shop would then be kept much cleaner and a lot of obscene language would be avoided.

All pits in the erecting shop should be kept as clean as possible, well drained and of suitable length and depth so that they may be convenient for the men to work in.

Other Factors Tending Toward Efficiency

In the larger shops particular attention is given to crane service. In the majority of shops, however, ample crane service is conspicuous by its absence, although it is just as essential in the smaller shop as in the larger. It is a great time saver to have ample crane service. This service can be abused, of course, but this may be checked by good supervision.

As soon as an engine is stripped and the parts cleaned, the foreman should see that the various parts are distributed to the different departments as soon as possible and should follow them up as closely as is consistent so that no delay occurs. In the event that he thinks certain parts are going to be late in getting out, he should report at once to the general foreman so that he may take care of it, as often times he has pushed something ahead of them. Particular attention should be paid to the running gear, such as wheels, driving boxes, etc., to see that they are being pushed by the machine shop for after an engine is wheeled the rest of the work goes along nicely if well managed.

The distribution of the classes of engines on the erecting floor is an important factor when output is considered. Care should be taken not to have too many of one class, or too many in for general overhauling or heavy repairs at the same time. The shopping of engines should be well balanced; that is, so many general, so many heavy and a certain number for light repairs.

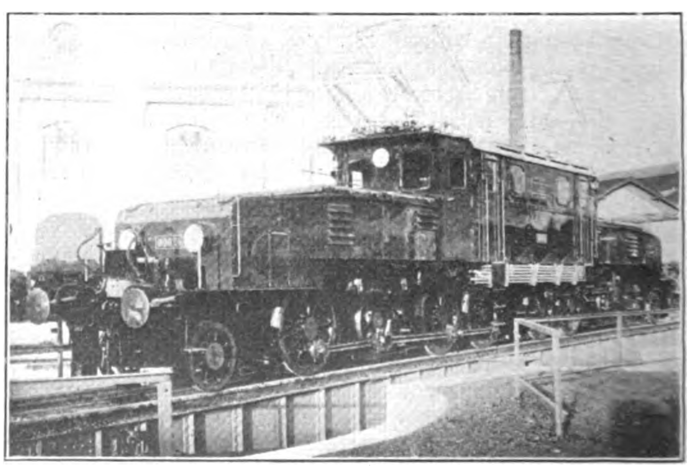
Another important factor is having the employees in each department well balanced. If the erecting department is undermanned, the other departments will flood it with finished work, or, on the other hand if there are too many on the erecting side, more or less time is wasted waiting for this or that and this does not make for efficiency.

Another factor tending towards efficiency of the erecting floor is keeping close watch over parts so broken or worn that they need replacing. Requisitions for such material should be made on the storehouse at the earliest possible moment and if in stock should be drawn out and gotten to the machine shop and the foreman of that department advised of what is required. If parts are not in stock, the general foreman should be notified so that he may follow up the requisition and bring pressure to bear where it will be the most effective.

Special attention will be paid by an efficient erecting foreman to the frames of the locomotive. He should be sure that the jaws are squared and the binders a good fit and well bolted. Shoes and wedges should bear well on the face of the jaw and not on the fillets, which might thereby cause the flange to break off. Driving boxes should be well fitted between the shoe and wedge for there you have the foundation of your engine. If these parts are well maintained the time between shoppings will be materially prolonged.

One great trouble is that some of the men higher up have the word "output" so obscuring their vision that sufficient time is not given to the man in charge of the erecting department to do a first-class job. Their slogan seems to be "get it together in as short a time as possible, regardless of the quality of the job." If more attention was paid to the quality of the work done the time between shoppings would be reduced materially and the locomotive would be in service and earning dividends during a larger percentage of the time. I do not want to be understood as advocating taking more time than is absolutely necessary, but if a job is worth doing at all it is worth doing right. This will enable the locomotive to give better service, require less attention in the roundhouse and therefore be a more economical unit.

There are a number of other ways in which an erecting foreman may increase the efficiency of his department: By having his men well organized, by quick distribution of his work to the other departments and following it up in due time, and by keeping a good supply of small materials on hand so that if a stud or nut is required he can furnish it without loss of time. Last, but not least, by keeping his men well satisfied, working with them instead of the men working for him, and by both working in the common interest of the railroad employing them.



Gilliams Service

One of the New Locomotives for Austria's Electrification

The Fatigue Element in Accident Prevention*

Accidents Apparently Vary in Direct Proportion to Fatigue—Human Machine Requires Scientific Attention

By William Baum

President, William Baum & Co., Consulting Engineers, Milwaukee, Wis.

IN our day of highly developed industries, the success of a manufacturing enterprise depends greatly upon the care given to machinery and materials. Nothing can be left to chance. Types of machines are selected to suit existing conditions and to operate at the proper speed with a minimum of friction. Steps are taken to prevent overloading and overheating. The greatest output is maintained consistent with long life and low depreciation.

However, the mastery of these technical and economic phases of manufacturing is insufficient in a modern plant.

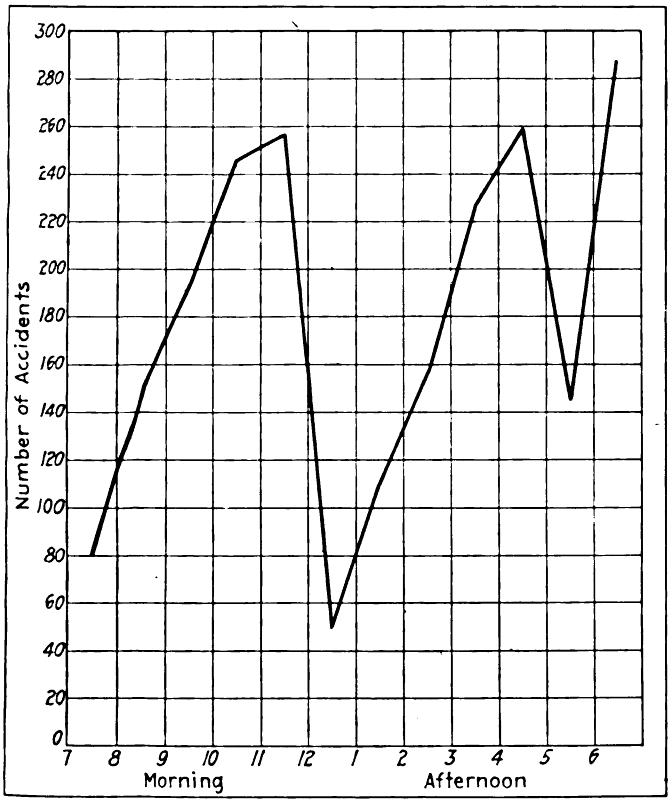


Fig. 1—Relation of Fatigue to Accidents—As to Time of Day

During the last few years, industrial executives have come to the realization that there is another problem which equals or even surpasses in importance that of mechanical devices and materials—the problem of the human machine. A. P. Fleming, one of the ablest electrical engineers in England, summarized his opinion in these words: "I have no hesitation in suggesting that the most important of all the problems with which we have to deal, and one which will be of increasing importance in the future, concerns the human element in industry."

The safety movement deals primarily with the human machine. Its leaders have long recognized the fact that the prevention of accidents increases output, reduces manufacturing costs and is of great benefit to the workers. This movement, based on economic and humanitarian motives, commands our full support and co-operation. It is not generally appreciated that fatigue causes accidents and that the fear of accidents causes fatigue.

What is fatigue? What are its causes and effects?

What is Fatigue?

All work, either physical or mental, produces in the body poisonous substances causing fatigue. The degree of fatigue depends, of course, upon the condition of the worker. The same amount of effort will produce greater weariness in a weak person than in a strong person; in a person poorly nourished than in one well nourished; and in boys and girls more than in grown-up men. Many people who are always tired suffer from intestinal poisoning, the results of indigestion being similar to those of excessive work. We have an analogy in the automobile engine which becomes fatigued when there is an excess of carbon in the cylinders. This carbon must be gotten rid of before the car can operate satisfactorily. In the human machine, the indigestible portions of food are waste matter, just as carbon is the incombustible

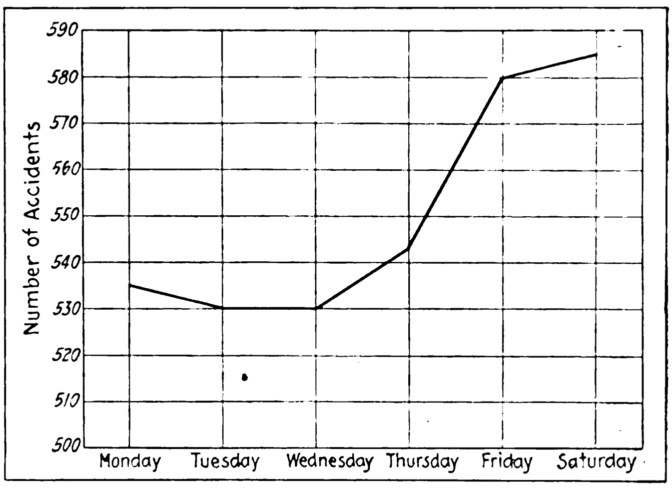


Fig. 2—Relation of Fatigue to Accidents—As to Day of Week

portion of gasoline in the automobile engine. Both must be eliminated.

There is a distinct connection between fatigue and accidents. In the hours when fatigue of the worker is still slight, there are scarcely any accidents, while in the sections of the working day when fatigue has grown to an appreciable extent, the number of accidents increases. This is clearly illustrated in Fig. 1, which shows the relation of accidents to the hours of the working day. Between 11:00 and 12:00 o'clock in the morning, and between 4:00 and 5:00 o'clock

*An address delivered at the Foremen's Safety School, Milwaukee, Wis., January 15, 1924. This school is conducted by the Milwaukee Association of Commerce Safety Division, which is affiliated with the National Safety Council. The sessions are held once a month during December, January, February, March and April. Sectional meetings are held from 7:45 to 8:30 p. m.; These include the following sections: Machine shop, sheet metal, textile, woodworking, building construction, foundry, electrical, packers and tanners, and an All-Trades Section to cover trades not included in the other sections. After a brief recess following the sectional meetings, general sessions are held from 8:45 to 9:30. The school is open to foremen, assistant foremen, superintendents, managers, safety supervisors and members of safety committees. In general, important phases of industrial betterment are covered, including accident prevention, production, labor turnover, fire prevention and leadership.

in the afternoon, when fatigue has grown, the largest number of accidents occur.

The relation of accidents to the days of the week, shown in Fig. 2, is of considerable interest. On Monday, the number of accidents is slightly larger than on Tuesday and Wednesday, a fact well known to industrial managers. Toward the end of the week, the accident curve rises sharply, reaching its maximum on Saturday (full day). That an increase of fatigue endangers safety, could be shown by numerous statistical data collected by governments and insurance companies.

Minimizing Fatigue

The difficult problem arises as to how to eliminate or at least minimize fatigue. The conclusions which can be derived from the curves suggest the introduction of rest periods and a shortening of the working day. In Europe, short rest pauses in the morning and afternoon are quite common, and it is claimed that the results are more satisfactory, particularly from the standpoint of output. It is impossible to specify the correct number of working hours per day to fit all cases. The best results will be obtained by a careful adjustment of the working hours to the conditions of the operation concerned.

General improvements in the working conditions contribute greatly to the elimination of fatigue. Dazzling lights improperly arranged, which strain and irritate the worker's eyes, should be avoided. Ventilation may often be improved; dry air can be washed and moistened. Noise, a great cause of fatigue, should be reduced as far as possible. Chairs for work and rest may be designed to be more comfortable. Workers should have sufficient time to eat their lunch without hurry, so that digestion is facilitated. The management has many other opportunities to do its share toward the elimination of fatigue, the reduction of accidents and the increase of efficiency in the plant. A scientific analysis of all factory operations will greatly contribute to the elimination of fatigue. It has been shown that a motion study usually reveals useless, ill-directed and inefficient movements of the workers. As soon as these false movements are discarded, the worker can perform the operation with the least effort and the largest resulting wages.

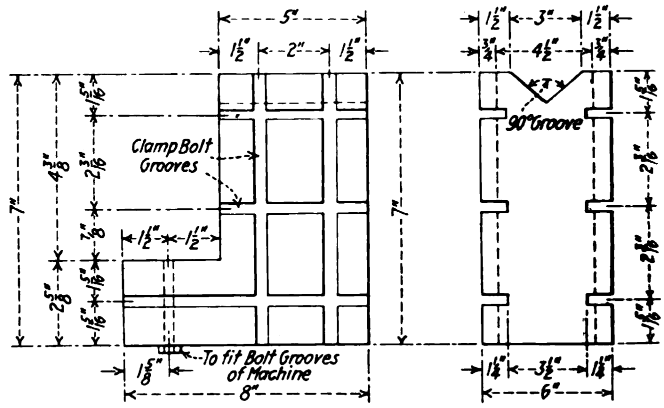
Relation of Fatigue to State of Mind

There is no question that the worker's state of mind bears an important relation to fatigue. If wages are too low or unequalized, the workers become dissatisfied, output suffers and fatigue increases. The importance of well equalized production standards and wage rates cannot be overstated. The only available methods to bring about equalized conditions is through "time study," a procedure which times the elements of the operations, adding suitable allowances for fatigue and personal requirements. A further improvement may be made by introducing a wage incentive plan which is based on these time studies and which establishes the identity of interests between employer and employees. There are many concerns today which operate so-called gain-sharing plans with the result that production per operator and earnings per hour increase, manufacturing costs and labor turnover decrease and accidents are rare. Such results are possible only if working conditions are as good as they can be made.

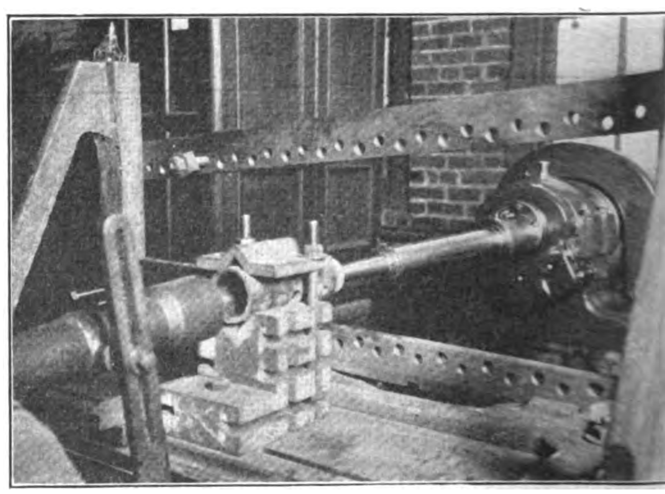
The problem of handling labor on a scientific basis is still regarded by many as academic and impractical. There are as yet many conservative employers who prefer to rely upon their past experiences in dealing with the problems of labor. But the day is approaching when executives will take advantage of the experiences of those who have taken the time to analyze the human machine with the same care and scientific attitude that is applied to the mechanical machine. Questions of safety, output, costs and efficiency cannot be divorced from the human element. Industrial peace and prosperity can be made a reality through concerted efforts based upon scientific principles and dictated by high-minded motives.

A Jig for the Heald Grinding Machine

A HEALD internal grinding machine can be readily utilized for grinding air pump main valve bushings and small work of a similar nature by the use of the jig shown in the sketch. The jig is made of cast steel with a base 8 in. by 6 in. and is 7 in. high. This height is sufficient to permit any necessary vertical adjustment of the table. A groove 3 in. wide and having a 45 deg. slope is machined across the top for holding the work. As shown in the illustration, the work to be ground is placed in this groove and is then clamped down to the jig by bolts, the heads of which fit in slots machined on the side for this purpose. The jig itself is secured to the table by means of a single bolt. The head of this bolt fits in a T-slot in the table and extends up through the base of the jig. The jig is prevented from turning by bolting a block on the table against the side or back.

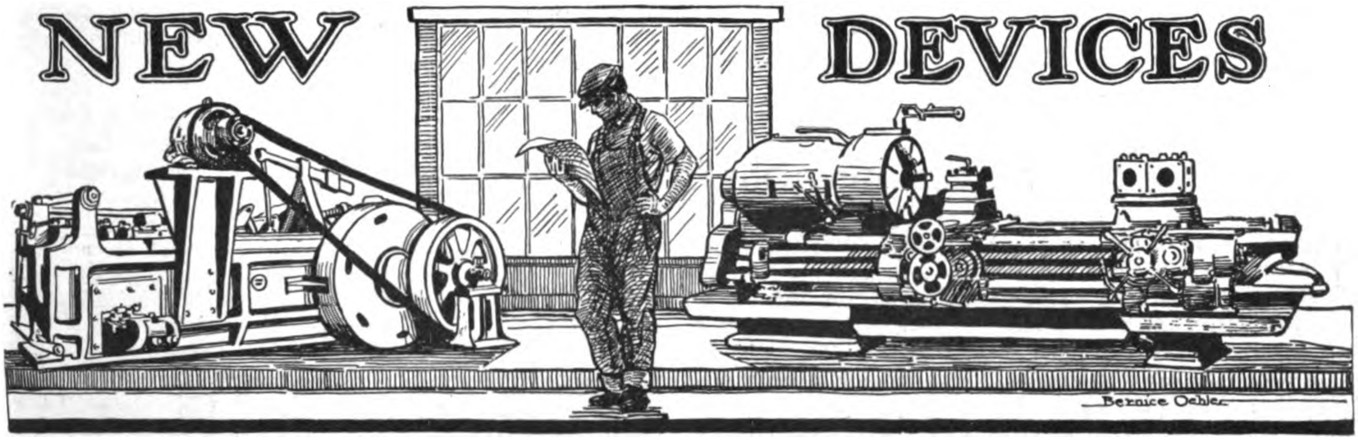


This Jig is Used for Grinding Air Pump Valve Bushings on a Heald Machine



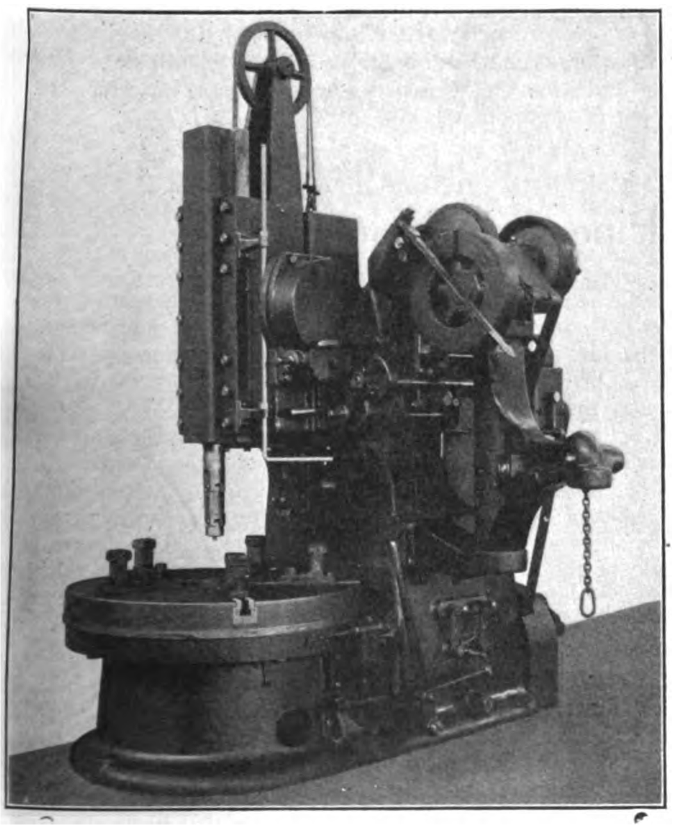
View Showing the Jig Holding a Valve Bushing That Is Being Finished on the Inside

The work is removed and replaced in the jig by loosening or tightening the nuts on the clamping bolts.



Car Wheel Borer with Labor-Saving Features

THE Betts Machine Works of the Consolidated Machine Tool Corporation, Rochester, N. Y., has developed a new design of car wheel boring machine with several new features of labor-saving value. These features include an automatic chuck and independent power rapid traverse to both the boring and facing spindles. This enables the workman to perform all the operations that are necessary with the least amount of manual labor and in the quickest possible time. The controls and levers are placed within easy reach of the operator and any desired adjustments of the tool may be made easily and quickly.



A Car Wheel Borer Equipped with an Automatic Chuck and Power Traverse

The boring spindle is of heavy rectangular section. The facing spindle is self-contained in the frame of the machine and has a bearing in a square guide on the under side of the frame, thereby supporting the facing tool close to the cut. The facing tool slide has sufficient vertical adjustment to accommodate the varying heights of wheel hubs. The power rapid traverse of the boring and facing spindles is independent so that rapid traverse may be used on one while feed is being used on the other. This feature allows the operator quickly to raise the spindle by power when the wheel is bored. This is done by simply throwing the rapid traverse lever in the direction the operator desires to move the spindle.

Six feeds are provided to both heads. These feeds are obtained through selective sliding steel gears which may be changed while the machine is running. When the roughing cutter has passed through the wheel, the operator can throw the proper feed lever, thereby instantly throwing in the finishing feed without stopping the table. Two-in-one boring tools can be used to the greatest advantage. The boring spindle is also equipped with a counterbalance weight so that it may be raised and lowered by means of a crank handle. This is a convenient arrangement in case it is desired to make close adjustment. When the spindle is elevated, this counterbalance weight enters a chamber in the frame and is, therefore, out of the way of the operator. In the design of the machine the manufacturers devoted a great deal of time and attention to improvement for facilitating the work.

The automatic chuck is controlled by a reversing friction clutch so that it is unnecessary to stop or reverse the motor when closing or opening the chuck. When the driving clutch is thrown in, the table starts to rotate and the jaws move towards the center, gripping the wheels with the full driving force of the motor, and the heavier the cut the tighter the jaws will grip. When the bore is finished, the table is stopped by means of a band brake operated by a foot treadle and the clutch is then thrown to the reverse direction, causing the jaws to open instantly, without stopping the motor. This band brake also serves the purpose of enabling the operator to stop the table and caliper the bore of the wheel without any danger whatever of loosening the grip of the jaws on the wheel. The treadle is located at the side of the machine in a convenient position for the operator.

Four table speeds in geometrical progression are provided and are obtained through hardened steel sliding gears located in the base of the frame where they run in a bath of oil. Either the mechanical hoist, as shown in the illustration, or the pneumatic hoist may be supplied. In case the mechanical hoist is used, it is driven by a belt from the main drive shaft so that only one motor is required per

machine. All control levers are located on the right hand or operating side of the machine where they are within easy reach of the workman at all times. This machine has a capacity for boring wheels up to 42 in. in diameter, the table being 52 in. in diameter. It can be furnished either with or without a facing tool for finishing the hubs.

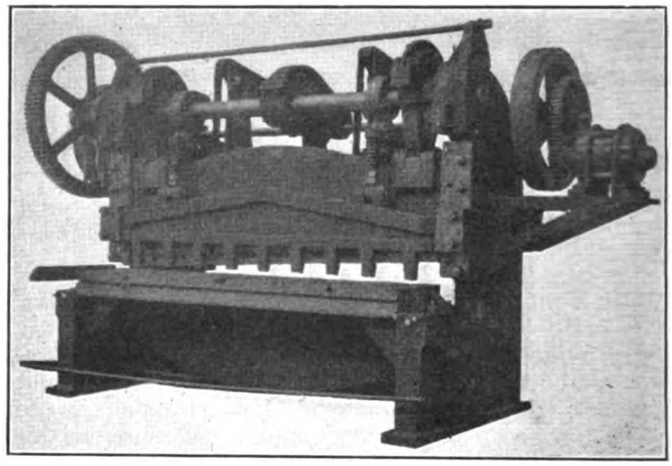
Power Squaring Shear with Overhead Drive

BERTSCH & COMPANY, Cambridge City, Ind., has recently begun the manufacture of a power squaring shear equipped with an automatic hold-down which is self-adjusting for sheets of different thicknesses. This hold-down is so constructed that the operator can see the shearing line at any point on the table. The machine is operated at about 35 strokes per minute by a 10-hp. constant speed motor running at about 1,100 r. p. m. The principal castings used in its construction, including the gears, are made of semi-steel.

The frame bearings for the eccentric shaft have split boxes which may be adjusted to take up wear. This arrangement also permits the removal of the eccentric shaft without dismantling the frames. The crosshead bearings are provided with gibs to take the wear and also to keep the blades in proper alinement. The blades have four cutting edges that may be reversed as desired. The table is adjustable to allow for regrinding the blades.

One of the special features of the machine is the arrangement of the center bearing on the back side of the crosshead. This makes the machine more rigid and tends to keep the blades in alinement. This bearing is held by a heavy cross-tie casting bolted to the frame and is made adjustable to take up wear.

This machine, known as the No. 4 overhead driven power squaring shear, has a 6-in. throat and is 8 ft. 4 in. between housings, with a capacity to cut 1/4-in. and lighter soft steel sheets up to 8 ft. in length. Center bearings are provided for the crosshead, eccentric shaft and driving shaft. An automatic clutch with hardened steel jaws, and cut gears,



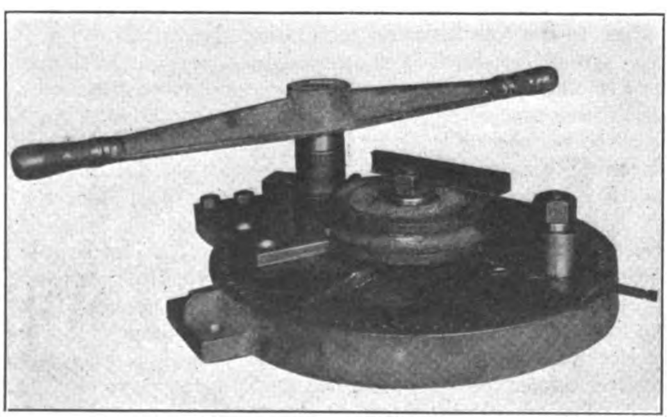
A Power Squaring Shear of Rigid Construction

are also important features of the design. A full set of front, rear and side gages is furnished with the machine. Its weight is approximately 25,000 lb.

Machine for Bending Pipe and Tubing

A PIPE bending machine capable of bending brass, copper or steel tubing without the liability of crimping or flattening has recently been developed by the Pedrick Tool & Machine Company, Philadelphia, Pa.

As shown by the illustration, the device is of comparatively simple construction. A face plate, with gear teeth cut on its



Pipe-Bending Machine with Grooved Roll in Place

periphery, is made to revolve in an outer casing. A hand lever is attached to a pinion which meshes with the face plate, thereby increasing the leverage so that its operation requires little manual effort. A flat steel piece containing a number of holes for the adjustment of the resistance stud, is attached to the outer casting in such a manner that it does not move with the face plate. An upright stud fastened to the face plate is adjusted radially by a set screw. This stud is provided with a roller in order to reduce the friction of carrying the pipe around the form.

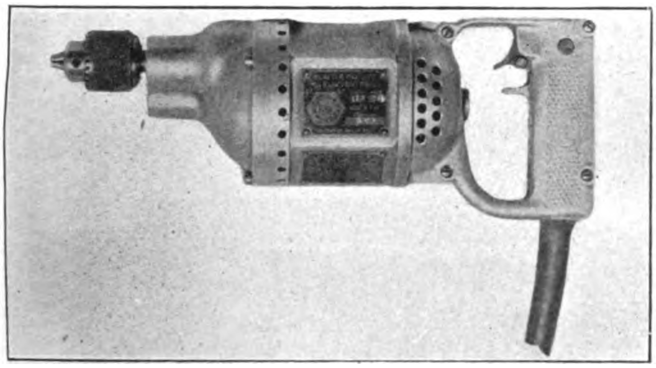
Located in the center of the machine is another stud over which are slipped the grooved rolls of the desired size. These rolls are made with various sized grooves to suit the diameter of the pipe or tubing to be bent and also in various radii in order to obtain the shape desired. The degree or angle of the bend is determined by the arc through which the face plate is moved. As the machine can be set to any bending radius, the number of identical shapes that can be made is practically unlimited.

The machine may be bolted to a stand, bench or stanchion and it can handle any length of pipe. Rolls can be used that will take all sizes up to 4 in. in diameter. Short pieces are easy to handle and this permits cutting to length, threading if necessary, and then bending to the desired radius.

Where the tubing is of heavy material with walls approximately as thick as ordinary wrought iron and steel pipe, bending is not a difficult problem, but anyone who has attempted to bend thin tubing knows the ease with which it is dented, crimped or flattened. It has been the usual practice to fill such tubing with sand, resin or some other reinforcing material to prevent such trouble, but this method has not always been satisfactory. It is claimed by the manufacturers that this machine will eliminate any liability of undesirable distortion.

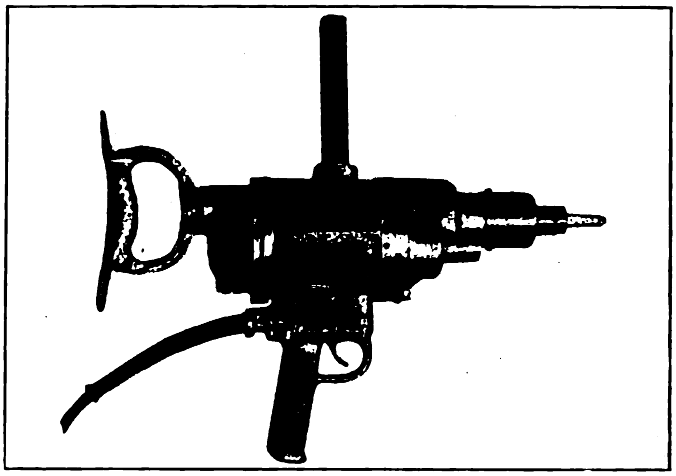
Two Electric Hand Tool Developments

TWO developments in the adaptation of electric driven hand tools to railroad shop work are shown in the illustrations. The tools are manufactured by the Black & Decker Company, Baltimore, Md. One is a portable electric drill with a capacity for handling any size drill up to 5/16 in. in steel. This drill is similar in design to the Black & Decker ¼-in. drill, but has a more powerful motor and other parts in proportion to its size. It is equipped with a three-jaw gear nut chuck for straight shank drill bits. It weighs seven pounds and has a no load speed of 1,400 r.p.m. It is equipped with pistol grip and trigger switch.



Black & Decker Portable Electric Drill

The other tool is known as the No. 3 electric screw driver and socket wrench. The tool has been designed for heavy production work and for driving large wood screws, lag screws, and running up nuts on large bolts. The spindle is equipped with a positive clutch which automatically disengages when the forward pressure on the tool is released. The patented pistol grip and trigger switch, as shown in the illustration, is standard equipment on this tool. A universal motor is used to furnish the power and it can be supplied for all standard voltages up to 250 volts.

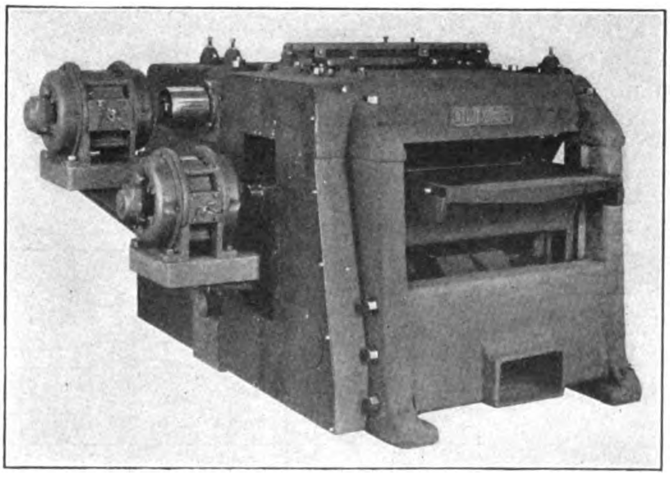


Portable Electric Screw Driver and Socket Wrench

A Double Surfacer for Heavy Production

AS the result of a careful study of the requirements of a production surfacing machine, the Oliver Machinery Company, Grand Rapids, Mich., has developed a surfacer which is intended to give continuous service under high speeds for finishing work, as well as under heavy duty high speed roughing cuts. This machine is built in two sizes to surface simultaneously two sides of work up to 30 in. or 36 in. wide and up to 8 in. thick, at four rates of speed; namely, 26 ft., 46 ft., 72 ft. and 108 ft. per min. The top cylinder will take cuts up to ¾ in. thick and the bottom cylinder will take cuts up to ⅛ in. thick. The bottom cylinder may be lowered below the bed line, allowing the machine to be used as a single surfacer if desired. Pieces as short as 6 in. when feeding continuously and as short as 21 in. when feeding one at a time may be surfaced without dubbing the ends. Sectional infeed rolls and a sectional chip breaker are regularly furnished with 2-in. sections to enable many narrow strips to be surfaced simultaneously, thus increasing the production of the machine. The knives of the top cylinder can be quickly jointed without stopping the machine assuring greater production hours. This is also an improvement in the design of the machine on account of the time it formerly required to do this work.

An exclusive feature of this machine is the improved design of the pressure bars and outfeed pressure plate. This improvement eliminates dubbing the ends of the work or causing wavy cuts and thus assures uniform thickness. The bearings of the feed system are of a special alloy anti-friction bronze and are easily replaceable. Two double-row ball bearings are used at each end of both the top and bottom cylinders, with a distance collar and large lubricating chamber. This arrangement tends to minimize friction and to resist any bounding tendency of the cylinders. The Alemite system of lubrication is used for all bearings. A unit system of construction is used in which all the major parts with their accessories are assembled together and located in the machine as a unit. All moving parts are enclosed and guarded.



Improved Surfacing Machine Designed for Continuous Service at High Speeds

The power hoist for the bed has an automatic release to eliminate any possibility of damage due to the operator's neglect. The bottom cylinder housing has a self-contained bracket supporting the table, on which the bottom cylinder

yoke slides out for quick setting and jointing, and for grinding the knives. Grinding can be done without removing the cylinder from the machine. A built-in shaving chute directs shavings from the bottom cylinder towards the rear of the machine and provision has been made for an exhaust connection.

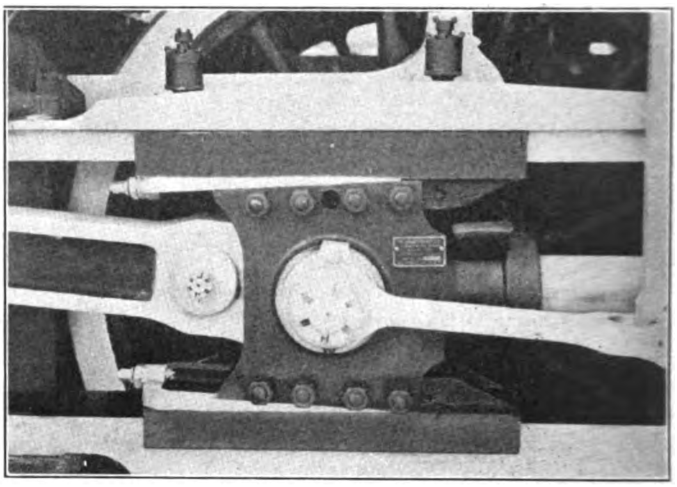
Improvements in the Rogatchoff Adjustable Cros-head

CONTINUED and extended use on heavy freight and passenger locomotives of the adjustable crosshead made by the Rogatchoff Company, Baltimore, Md., has shown the possibility of some small improvements in the details of construction, which have been incorporated in those lately applied. The square nut on the inner end of the wedge bolt is now fitted snugly with a 12-in. wrench fit, and after it has been applied, the extended end is upset, as indicated in the detail drawing. After the wedge bolt and wedge have been assembled and the outer hexagon nuts adjusted and locked, a washer with a square hole is slipped over the end of the bolt and electrically welded in place. Its consequently is impossible for the locks nuts to come off and be lost.

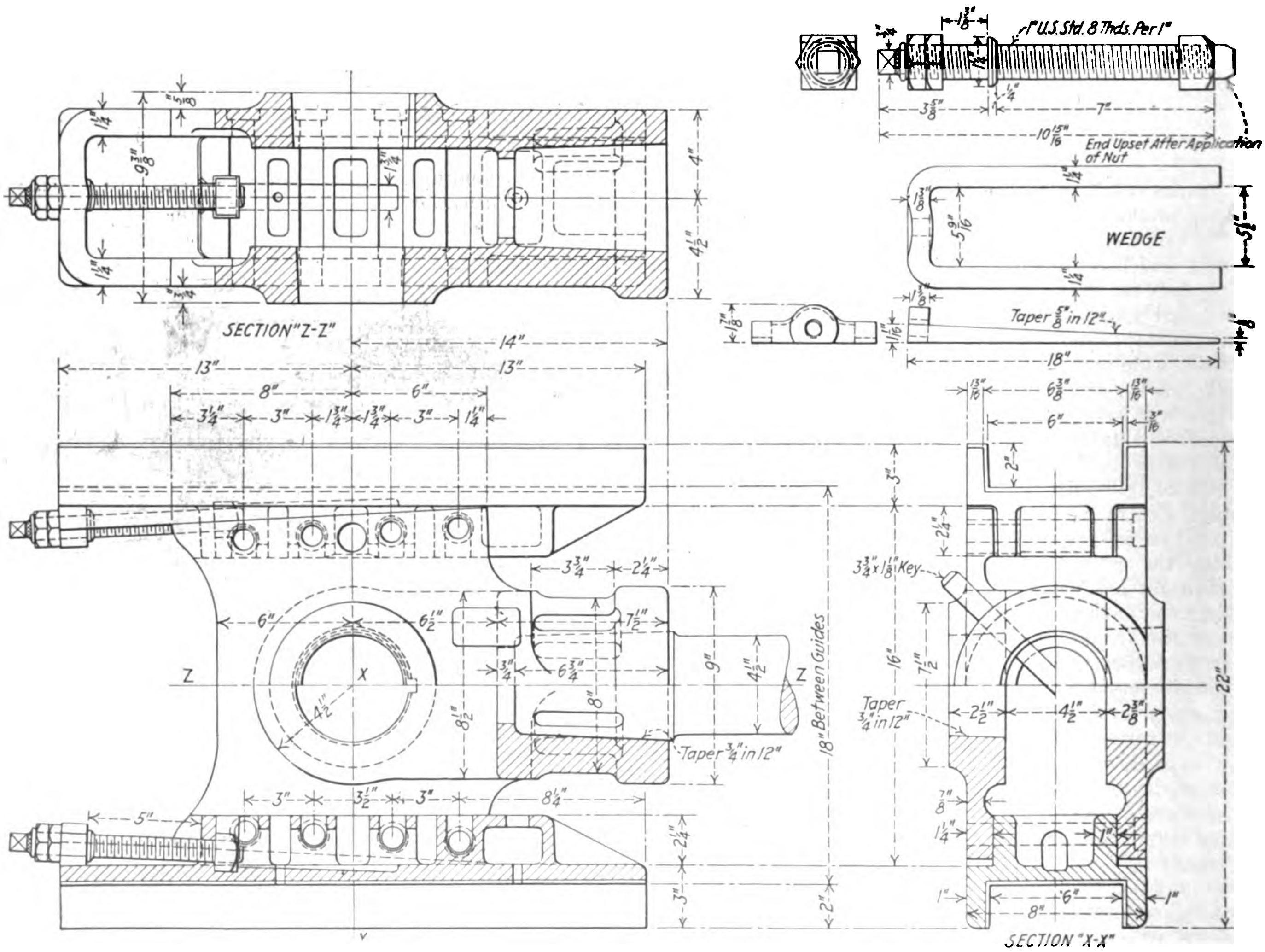
As now made, the adjusting feature has been rendered practically fool-proof. Even though the bolt should be turned the wrong way and left loose, it cannot come apart.

After the lost motion has been taken up by the wedge and the slipper and crosshead body have been locked by the through bolts, the wedge is then no longer depended upon.

The portion of the shoes which fits between the crosshead sides is now machined with straight parallel sides instead of tapered sides, as employed on early installations. No fundamental modifications, however, have been found necessary to improve the adjusting features, which have been used for some time.



Installation of the Rogatchoff Crosshead Showing Wedges and Shoe Bolts



Rogatchoff Crosshead as Applied to Canadian National 2-8-2 Type Locomotives

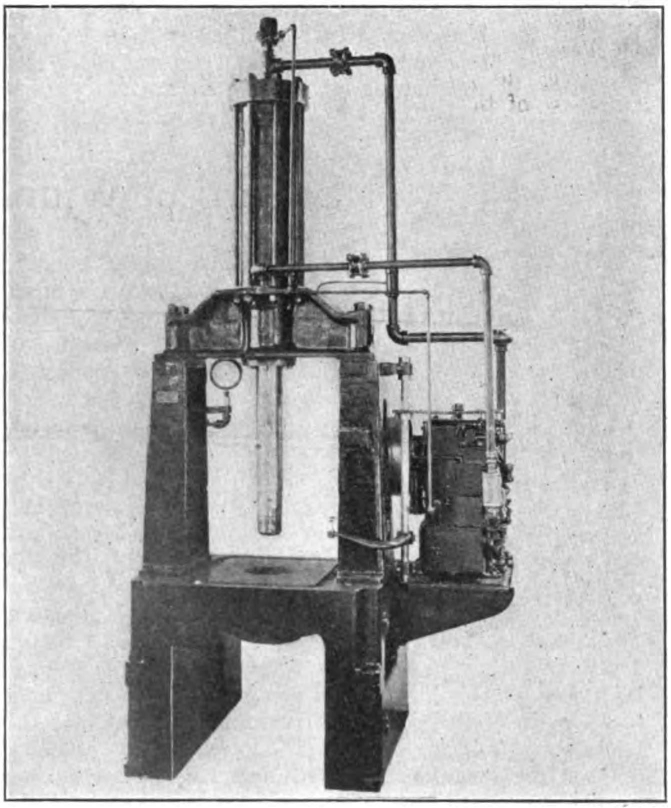
A Two-Column Hydraulic Press

THE Oilgear Company, Milwaukee, Wis., has announced a new line of self-contained, two-column hydraulic presses. These presses are built in several sizes, ranging from 15 to 50 tons' capacity and with the platen placed either 14 in. or 30 in. from the floor. The daylight space, width between the columns, and stroke of the ram are dimensioned to suit the requirements of a variety of work. These presses are equipped with a pump having a maximum delivery of 3,060 cu. in. of oil per min. and a maximum pressure of 1,000 lb. per sq. in. Several control mechanisms can be furnished for the pump, such as a plain hand control, as shown in the illustration, foot treadle or semi-automatic control. In all cases a single-acting lever gives instant control of rapid advance and return of the ram, and also controls the pressing speeds regardless of the resistance.

A differential quick advance to the rame can be obtained with either a hand lever or foot treadle control, which will allow the ram to be advanced to the work at double the pressing speed. The pump is so protected that the ram may be run against a positive stop without injury.

These presses have been designed for broaching, assembling, die work, forming, embossing, stacking, straightening and miscellaneous work where pressing action is required. One of their features is that the ram may be run against the work to any predetermined pressure and held at that pressure indefinitely, without pulsation.

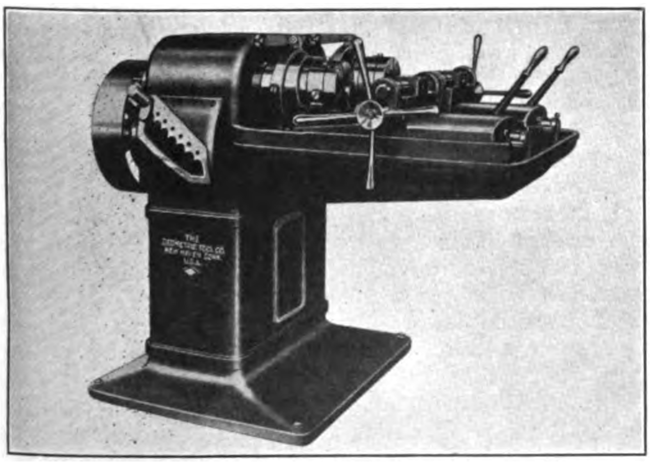
The principal claims are sensitiveness of control and a smooth, positive motion of the ram, all in a self-contained unit requiring no accumulator. There are no expensive operating valves. The press can be driven from any constant speed source of power and is fully protected against damage from stalling or over-running.



Self-Contained Hydraulic Press Built in Sizes Varying from 15 to 20 Tons

A Double Spindle Threading Machine

A MACHINE designed primarily for threading work in which the threading time for both pieces is sufficient to allow the operator to check and start a second piece while the first is being completed, is now manufactured by the Geometric Tool Company, New Haven, Conn. A number of threading combinations are possible with this machine. Both spindles may be fitted with die heads for external threading only or with collapsing taps for internal threading, or one spindle may carry a die head and the other a tap for handling work which requires both an external and internal thread. The same combination may also be employed for separate external and internal threading whenever work of such character is required.



Geometric Machine With a Wide Range of Threading Combinations

The bed of the machine consists of a casting, carrying the two spindles, which are mounted in large bronze bearings. The spindles are driven by a single pulley, located at the rear of the machine, but they can be driven independently by means of the change gear levers at either side of the machine. Each carriage is fitted with a two-jaw chuck. The chuck is operated by a hand wheel, and special bushings or holders can be furnished to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for a predetermined length of thread. An adjustable stop on the trip rod ahead of the carriage governs the opening of the die head and the length of the thread to be cut. The adjustable stop back of the carriage controls the closing of the die head.

Both spindles are operated and controlled in exactly the same manner. This facilitates the operation of the machine for the standpoint of production.

A single geared pump, driven from the main shaft by bevel gears and a flexible shaft, forces oil from the reservoir through the spindles and die heads against the work. When equipped with the collapsing tap or high speed tapping device, the oil is fed through pipes on the outside of the machine. The lubricating system may be easily removed for cleaning and inspection.

The change gear levers on the sides of the machine control the spindle speeds independently, and may be set to furnish the proper speeds for the threads being cut. The speed

given will be found satisfactory for the average run of work, but may be varied to suit special conditions. A safe cutting speed for any diameter is one which will insure the maximum production without causing excessive wear on the chasers. If the speed for which the machine is designed is too fast to permit this, it should be run more slowly, regardless of the index.

This machine will cut threads of the following diameters: 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8 and 1 1/2 in. The greatest cutting length at which the swinging gage can be set at one time is 9 in. With resettings, a length of 14 in. may be obtained. The floor space required is 48 in. by 65 in. The speed of the countershaft is 296 r.p.m., and the net weight of the machine, 2,165 lb.

Solder Pot With Automatic Heat Control

An electric solder pot with automatic heat control has been added to the line of devices manufactured by J. D. Wallace & Co., Chicago, Ill. The automatic control simplifies the problem of heating babbitt, white metal, wax and other materials that are slow conductors of heat. The main objective in its design is to overcome oxidation and it so operates that when the solder has been heated to 600 deg. F., an automatic control prevents a further rise in temperature. This control is an adaptation of the principle used in the steam gage. A volatile substance, which is very sensitive to heat, actuates a Bourden tube, which makes and breaks the electric circuit, thus controlling the temperature of the contents of the pot.

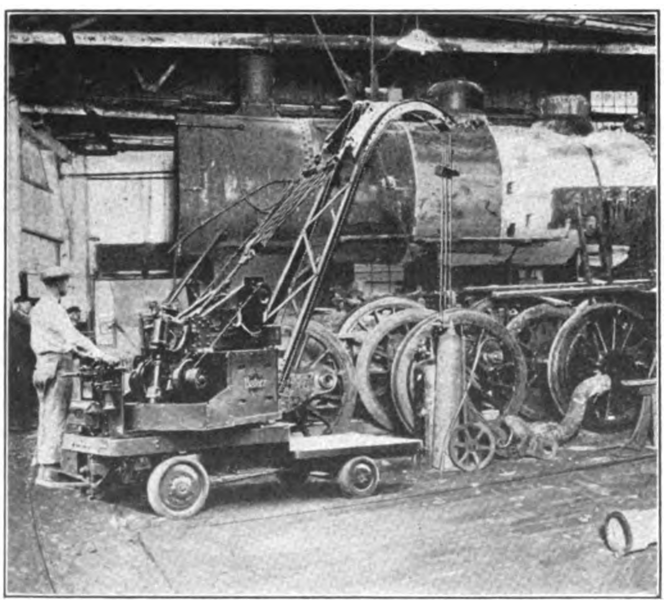
The pot will accommodate 15 lb. of solder and will heat this amount to 600 deg. F. in 20 to 25 min. Its quick action is due to the fact that a 900-watt heating element is built around the entire container and heat is thus applied to all parts of the sides and bottom of the container simultaneously.

Once the container is filled and current turned on, it requires no attention until refilling is necessary. The pot weighs only 13 lb. and operates on either 110-volt or 220-volt alternating or direct current.

This Solder Pot Eliminates Oxidation by Thermostatic Temperature Control

Locomotive Type Crane

The locomotive type crane, made by the Baker R & L Company, Cleveland, Ohio, has been completely redesigned for railroad use, the new crane, shown in the illustration, having a wide field of usefulness not only in enginehouses but in all railroad departments where heavy material must be handled without the aid of overhead traveling cranes. With an 8-ft. boom and 60-in. wheelbase the new crane may also be operated inside a standard box car and thus greatly reduce the number of laborers required for loading and unloading these cars.



A Baker Locomotive Type Crane Speeds Heavy Repair Work in an Enginehouse

For enginehouse use the new Baker crane can be provided with a standard 12-ft. or longer boom up to 19 ft. With the latter length a lift of 192 in. can be obtained at a 95-in. radius and the crane is therefore suitable for reaching over the tops of locomotives and removing front doors, dome casings or covers, dry pipes, air compressors, or other parts high up on the locomotive which ordinarily require the effort of several men and more or less laborious work to remove or apply.

A short, auxiliary boom can be furnished when desired for working underneath the running boards, greatly facilitating the removal of heavy rods, crossheads, pistons, etc., which on modern locomotives have far outgrown the point where they can be readily put up by hand. When not in use this auxiliary boom can be folded up out of the way.

The special feature of this crane is that all of its movements are electrically driven with one motor for propelling the trucks, a second for swiveling the crane and a third which drives the main hoist. The main hoist consists of two drums, one for lifting the hook and the other for racking the boom. Power is applied to either of these drums by means of magnetically-operated clutches.

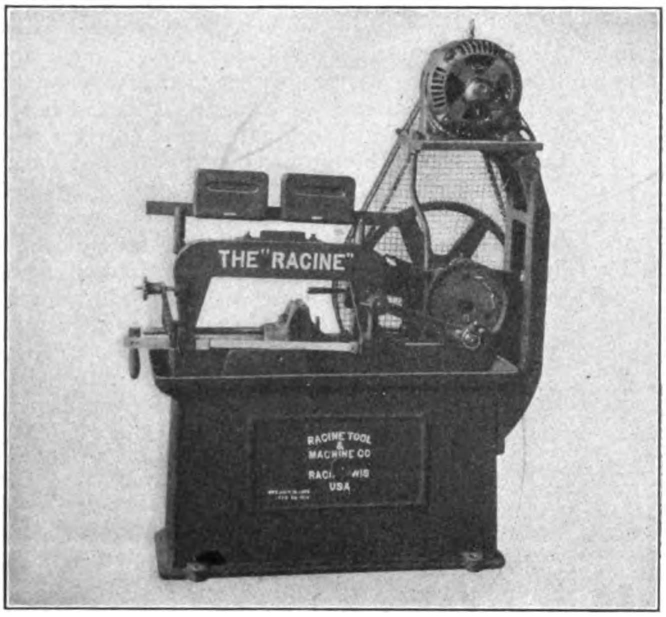
The rated capacity of the crane is 3,000 lb. at a 7 ft. radius, the hoisting speed at that load being 7 ft. per min. and the traveling speed 265 ft. per min. As shown in the illustration, the boom is long enough to perform practically all the heavy lifting, such as side rods, air pump and main reservoir, around a locomotive.

A Hack Saw Redesigned for Motor Drive

The Racine Tool & Machine Company, Racine, Wis., has redesigned its high speed hack saw, known as No. 2A, for operation by an electric motor. This machine is already in use in a number of railroad shops. With the exception of the driving mechanism, it is of the same construction as the regular No. 2A type. As shown in the illustration, the motor sets on a platform that is part of a bracket attached to the end of the bed. The saw is driven by a chain and sprocket wheel directly connected to the motor. The driving mechanism is entirely enclosed by a wire mesh safety guard.

The machine is equipped with a special three-speed transmission, which provides the proper speeds for cutting any kind of material. It is equipped with a quick-acting vise, which swivels on the table bed and grips the stock close up to the saw blade, thus enabling the operator to cut short pieces at any desired angle. As shown in the illustration, the vise is operated by means of a handle that extends beyond the end of the machine, which makes it easily accessible.

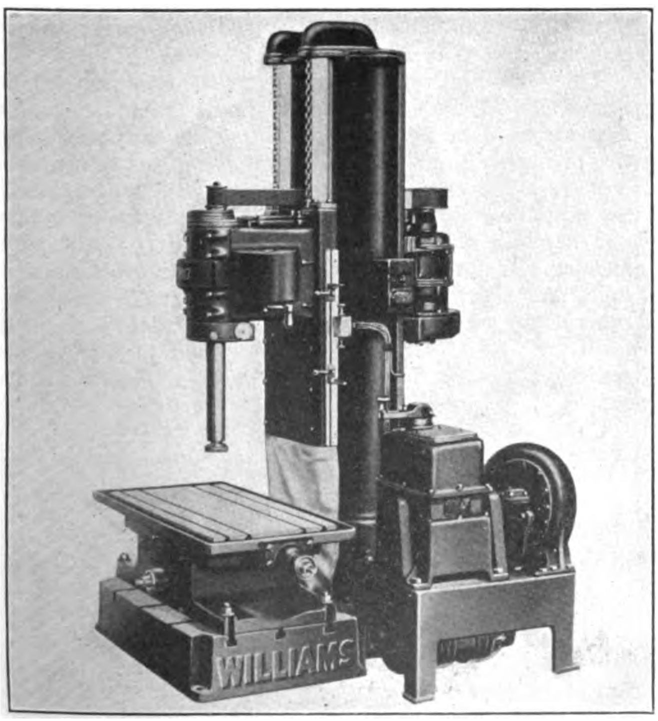
The lift for the non-cutting stroke is secured by an automatic device, which prevents the blade from dragging back, no matter how great the pressure. The blade cuts through the material by gravity which tends to prevent injury to the teeth. A positive circulating pump applies a cutting compound to the blade and an automatic stop throws out the clutch when the material is cut through. There are only ten moving parts in the machine. Its actual capacity is $6\frac{1}{2}$ in. by $6\frac{1}{2}$ in. and it uses blades from 10 in. to 14 in. in length. The floor space required is 30 in. by 44 in. and its net weight is 710 lb.



Belt Driven Hack Saw Which Has Been Redesigned for Motor Operation

Internal Grinder Equipped with Universal Table

A vertical internal grinder equipped with a suction fan for removing chips and dust, a dialing mechanism for adjusting the eccentrics and a universal table, has been placed upon the market by the Hi-Way Service Company, South Bend, Ind. This grinder is known as the Williams vertical cylinder grinder. The head consists of a unit casting and contains all the working parts, which are lubricated by oil bath, oil vapor and oilers. The arbor is made up of two eccentrics, one within the other, giving the grinding spindle a planetary adjustment for feeding the wheel to the work. It is driven through a worm and worm wheel by a two-speed motor that is mounted on the side of the head.



Vertical Grinder Driven by a Two-Horsepower Motor Mounted in the Rear of the Head

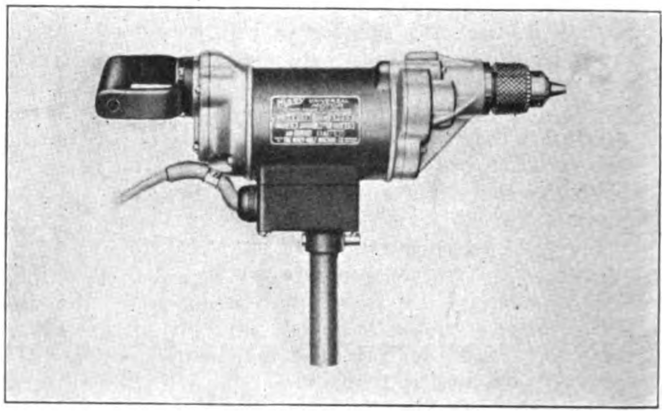
The grinding spindle rotates at a constant speed of 7,000 r.p.m. and is carried on a double row of annular ball bearings. These bearings carry the weight of the shaft and also take care of the thrust load. The center bearings are of bronze. The lower bearing at the grinding wheel end is made from high-grade bronze, tapering and adjustable to take up the wear. This spindle is driven from a two-horsepower vertical motor mounted on the rear of the head, through a flexible idler that maintains uniform belt tension. Various spindle speeds are provided by interchangeable pulleys on the wheel spindle and motor shaft, enabling the use of large or small diameter grinding wheels for grinding holes of different size.

This unit head and power plant can travel up and down between heavy columns at the will of the operator. The columns are provided with V-ways and heavy gibs that are counterbalanced by weights in each column. The column is of twin design, cast together at top and bottom, making a stiff and rigid casting. The ways provided for the head travel are cast integral, machined and hand scraped to a perfect fit.

The base is of heavy construction and supports the twin column and universal table. In grinding large single cylinders, the universal table can be removed from the T-slotted base and the work clamped direct onto the base which is also provided with slots.

Side Handle Portable Drill

A HIGH-SPEED portable drill suitable for wood and metal drilling has recently been placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The machine is of sturdy construction, small and compact, and is as light in weight as good practice will permit. All parts are easily accessible, which was made an important feature in its design in order to reduce maintenance costs. All bearing surfaces are equipped with ball bearings. The lubrication for all the bearings, gears and other moving parts in the gear end of the machine is supplied from the gear transmission case, while the ball bearing on the top head is packed with grease. All gears are machined and are heat treated in order to secure toughness and long life. The illustration shows the type designed for drilling hard metal, where a slow speed is often preferred. It can be operated on either 115 or 230 volts and runs at a no load speed of 1,250 r. p. m. At normal load, its speed is 760 r. p. m. and it has a capacity in steel of 5/16 in. It has an overall length of 14 in. and weighs 12 lb. in working order. A quick cable connector permits the making of cable repairs and renewals without dismantling the machine.



A Portable Electric Drill Adapted for Wood and Metal

Hose Coupling and Spider Hose Mender

IN view of the great amount of compressed air used in railroad shops, enginehouses and car repair tracks it is plain that this air should be used as economically as possible. Moreover the efficient operation of thousands of pneumatic tools is dependent on the supply of an adequate amount of compressed air at the pressure required to operate the tools. A leaky hose, if it occurs too often, is the cause of considerable waste and unnecessary expense.

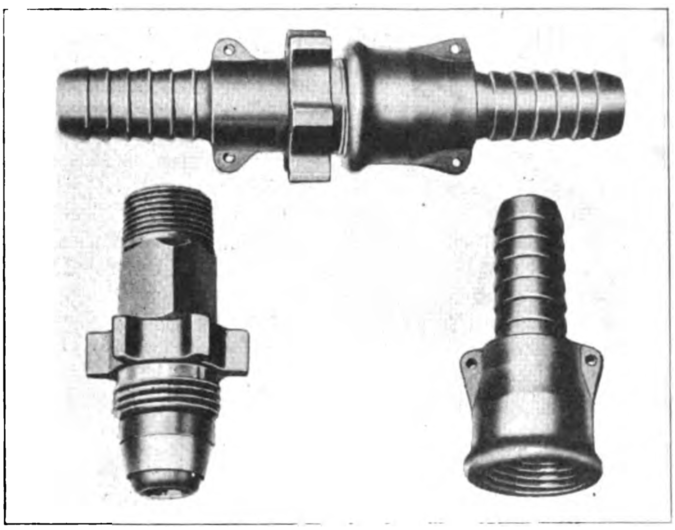


Fig. 1—Lowney Hose Coupling—Taper Gasket on Male End

Realizing these facts and their relation to tight hose connection fittings the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has developed a coupling and a Spider hose mender designed to be positively air tight. The coupling is a simple, positive connection without springs or locking teeth, the connection being made and wear taken up by turning a swivel nut.

Referring to Fig. 1 the construction of the coupling and its various parts will be evident. The gasket fits in a taper groove in the male end and turning the swivel nut forces the gasket against the shoulder in the female end. The gasket is said to be easily applied and not subject to blowing out. Special provision is made to prevent the couplings themselves from blowing out of the hose by a method of clamping shown in Fig. 2.

The G-B Spider hose member, that is shown below in Fig. 2 has been designed as a simple, rapid and effective method of splicing air hose or joining the ends after a defective piece has been cut out. In applying this fitting all that is necessary is to cut the ends of the hose square, lubricate the nipple ends of the mender, slip the hose over the nipples and hammer the points into the hose. It is said that this mender will not leak or pull out under high pressures. An important advantage of this device is that on account of its short length there is practically no interference with the flexibility of the hose. This coupling and mender has been recommended as a useful adjunct to the air line repair man's supply of material for making hasty repairs.

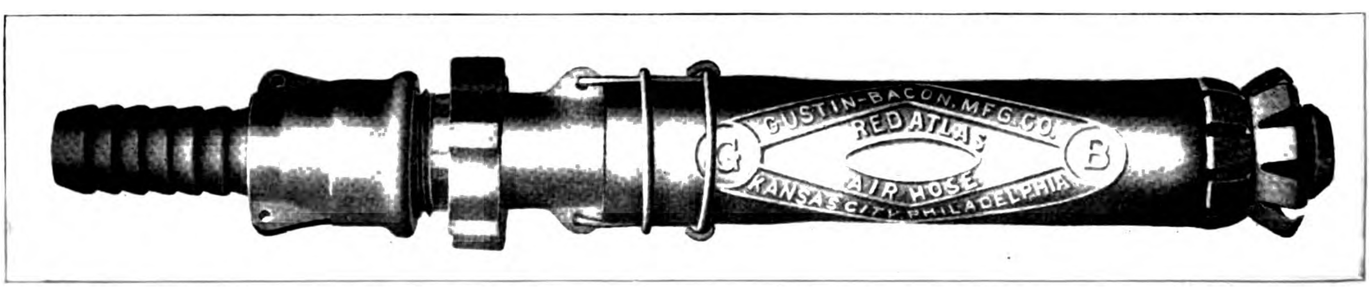


Fig. 2—View Showing Wire Clamp Arrangement and "Spider" Hose Mender

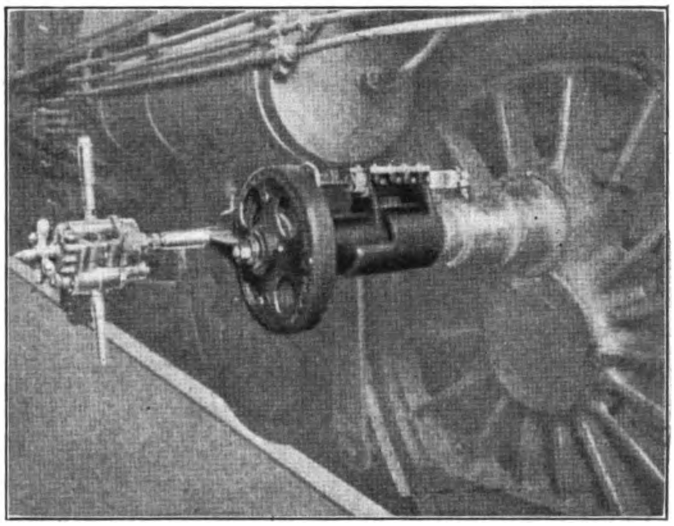
Portable Crank Pin Turning Machine

THE illustration shows a portable crank pin turning machine bolted to the end of a crank pin on a locomotive driving wheel. The H. B. Underwood Corporation, Philadelphia, Pa., manufacturers of this device, have developed this method of attaching the machine to the pin to assure perfect alignment of the cutting tool in respect to the axis of rotation. It is made in two sizes; one with a capacity for turning pins from 4 in. to 10 in. in diameter, with an extension slide up to 16 in. in length, and the other with a capacity for pins from 6 in. to 13½ in. in diameter and a 21-in. extension slide.

One of the advantages claimed for this machine is that the cutting tool and work is in full view of the operator at all times. The tool is fed longitudinally by a star wheel actuated feed screw. The feed is automatic, variable, and can be reversed as desired. The equipment, as shown in the illustration, is comparatively light and well balanced, which tends to insure a steady cutting speed and accurate work.

Its operation is simple. The stationary spindle is fastened to the end of the crank pin and the slide that holds the tool is revolved around the spindle. An adapter bushing aligns the tool concentric with the original center. Special adapter bushings may also be made for this machine to suit other types of work. A revolving sleeve, mounted on the spindle, carries the tool slide to which the cutting tool is fastened by means of a tool post and clamp screws. It is driven by machine-cut spur gearing, and can be adapted either for air, motor, pulley or hand power drive. The net weights of the two sizes of this machine are 411 lb. and 668 lb. respectively.

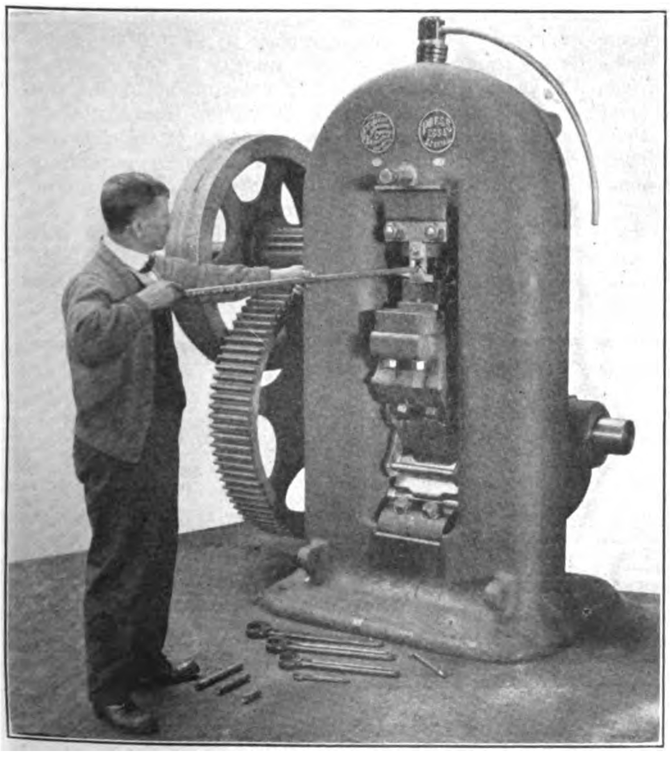
This crank pin turning machine has been successfully used in a large number of railroad shops. On account of its comparatively light weight it can be easily transported to any place desired around the shop and adjusted on the crank pin.



Portable Crank Pin Turning Machine Operated by Air Motor

Press for Producing Staybolt Blanks

THE illustration shows a coining press built by the Ferracute Machine Company, Bridgeton, N. J., fitted with dies and attachments required to produce staybolt blanks. The square head is formed and the bolt blank is cut from the end of the bar in the same operation. The average production for this machine is at a rate of 30 blanks per minute.



Making ⅞-inch Staybolt Blanks from a Steel Bar

The press is of compact construction, the frame being constructed from a solid casting with but 14 in. between the columns. The stroke of the press is 2 in. The ram is forced upward by the action of steel toggles which are actuated by a 6-in. steel shaft at the back of the press. The head, to which the upper die is attached, can be adjusted downward as much as ½ in. by means of a wedge adjustment operated by a screw. A bolt at the top of the press keeps the head firmly up against the frame. The spring shown in the illustration has sufficient tension to take the entire weight of the head when operating the wedge adjustment. The forming dies are V-shaped and there is an adjustable gage at the back of the press so that bolt blanks of various lengths may be cut off.

The operator is shown in the act of making ⅞-in. staybolt blanks from a steel bar of that diameter.

THE PENSIONERS of the Canadian Pacific Railway, now numbering 1,182, receive an average pension of $35.92 a month. Each pension includes a bonus, which has been allowed monthly, since May 1, 1919, on account of the abnormal increase in the cost of living. For 20 months, this bonus was 25 per cent, but since the beginning of this year, it has been 20 per cent. These and other facts about the pensioners have been given out in connection with an account of the twentieth anniversary of the establishment of the pension system. Employees of the company now number about 90,000, more than four times as many as were in the service in 1903, and the total payments by the company now amount to more than $500,000 a year. President E. W. Beatty, reviewing the 20 years' history, speaks of the pension as an inherent right of employees who have given faithful service to the company, and he classes this beneficial arrangement as an important aid in shaping the high standard of co-operation that exists between all branches of the company's service.

GENERAL NEWS

The shops of the Wabash Railway at Decatur, Ill., were damaged by fire on February 26, four buildings being practically destroyed; estimated loss $250,000.

C. E. Brooks, chief of motive power of the Canadian National Railways, has arrived in Sweden for an inspection of the Swedish railways and railway equipment manufacturing plants.

Motor passenger cars are now in use on 157 railroads in this country, according to a compilation made by the National Automobile Chamber of Commerce; about four times as many roads as were shown on a list made one year ago.

The proposal to amend Car Service Rule 12 was adopted by the A. R. A. and the amended rule became effective March 1, 1924. It now reads that "the placing of advertisements or banners of any kind, at any time, upon passenger or freight cars, or locomotives, is prohibited."

Henry La Rue, formerly master car builder of the Chicago, Rock Island & Pacific, has resigned as senior inspector of equipment of the Bureau of Valuation of the Interstate Commerce Commission, with office at Washington, D. C., to devote his time to personal affairs.

The Department of the Interior has issued Bulletin No. 223, in which the results of 36 combustion tests made on a 468-hp. boiler, fired with pulverized coal, at a power station of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., are given. The object of the tests was to obtain authoritative results of the performance of pulverized coal under various conditions of furnace operation as well as with coal of different fineness and moisture content.

The Interstate Commerce Commission's monthly report to the Senate on the condition of railroad equipment shows that during January, 102,676 freight cars were inspected by its Bureau of Safety of which 4.1 per cent were found defective and 1,766 passenger cars, of which 1.2 per cent were found defective. The Bureau of Locomotive Inspection during the month inspected 5,311 locomotives, of which 3,073 or 58 per cent were found defective and 737 were ordered out of service. There were 85 accidents during the month caused by the failure of some part or appurtenance of the locomotive or tender, in which 6 were killed and 93 were injured.

Wage Statistics for November

For the month of November, Class I railroads reported to the Interstate Commerce Commission 1,899,545 employees, an increase of 79,082 or 4.3 per cent over the number reported for November, 1922. The total compensation increased $399,311 or 0.2 per cent. The overtime compensation was $10,039,041 greater in November, 1922. The number of employees reported for the first eleven months of the year 1923 averages 1,887,590, an increase of 255,386 or 15.6 per cent as compared with 1922. The total compensation paid to employees of Class I railroads increased $386,990,898 or 16.0 per cent in this same period.

Santa Fe Organizes for Fuel Conservation

A fuel conservation organization has been established on the Atchison, Topeka & Santa Fe. The committee in charge consists of the fuel conservation engineer, four fuel supervisors covering the different general managers' territories and 14 division fuel supervisors. J. M. Nicholson, fuel conservation engineer, with headquarters at Topeka, Kan., is at the head of the work.

Safety Appliance Order Not to Be Revised

Following a conference of a committee representing the Bureau of Safety of the Interstate Commerce Commission, the Mechanical Division of the American Railway Association and the train service brotherhoods, called for the purpose of considering a revision of the commission's order of March 13, 1911, prescribing standards for safety appliances for equipment, to be submitted to the commission, it has been decided to leave the order in its present form.

Germany Gets Order for Locomotives for India

A locomotive manufacturer in Hanover, Germany, has secured an order for five locomotives from the government of India, according to a wireless dispatch from London to the New York Times. This order was placed in London by the High Commissioner for India who, however, had little choice in the awarding of the contract, since he had been instructed by the Indian legislature to place the order with the lowest bidder and the German bid was 40 per cent below that of the British bidder.

American Engineering Council

The organization of the American Engineering Council has been practically completed. This takes the place of the old association of the different engineering societies, known as the Federated American Engineering Societies. The constitution of the new organization contains a number of radical changes from that of the old Federation, of which the most outstanding is the provision for membership. It is now possible for technical sections or divisions of non-engineering organizations to be admitted to membership, as well as alumni associations of engineering schools and sections of non-member national societies. None of these were included under the constitution of the Federated American Engineering Societies. Another feature is that the membership is now restricted to organizations in the United States.

LOCOMOTIVE AND FREIGHT CAR REPAIR SITUATION

Date	Locomotives: No. locomotives on line	No. serviceable	No. stored serviceable	No. req. repairs over 24 hr.	Per cent req. repairs over 24 hr.
1923					
January 1	64,453	48,905	576	13,587	21.1
April 1	64,559	50,107	914	12,801	19.8
July 1	63,906	52,456	2,181	10,326	16.2
October 1	63,982	54,159	2,620	8,787	13.7
November 1	64,192	54,080	2,517	9,163	14.3
December 1	64,336	53,764	3,367	9,577	14.9
1924					
January 1	64,406	54,031	5,061	9,395	14.6

Date	Freight cars: No. freight cars on line	Cars awaiting heavy repairs	Cars awaiting light repairs	Total cars awaiting repairs	Per cent of cars awaiting repairs
1923					
January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	2,270,405	116,697	38,929	155,626	6.8
1924					
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8

Discontinuance of Bonus Hours

The Labor Board has ordered that Decision No. 222 and its addenda discontinue the allowance of a bonus hour to certain classes of employees engaged in night work. This decision was rendered in a dispute between the Railway Employees' Department, American Federation of Labor, and the Northern Pacific, the Great Northern, the Chicago, St. Paul, Minneapolis & Omaha, the Minneapolis, St. Paul & Sault Ste. Marie, the Minneapolis & St. Louis, and the Minnesota & International. On the question of whether certain classes, to whom the bonus hour had not previously been allowed, should be granted this allowance up to July 1, 1922, the board ordered against such an allowance. A dissenting opinion was filed by board member A. O. Wharton and a supporting opinion was filed by Chairman B. W. Hooper.—*Decision No.* 2071.

Trying to Beat Train to Crossing Negligence Sole Cause of Accident

In a crossing accident case there was evidence that the train which struck the automobile was moving very slowly, that the latter could have been stopped in four feet, that the brakeman's signals and yells to stop were seen and heard by occupants of the car, that the usual crossing sign was there, that three whistle blasts were blown and the automatic locomotive bell was ringing continuously. The District Court of Appeals, Eighth Circuit, holds that it was the negligence of the occupants of the automobile "and theirs alone, which caused the unfortunate accident, in attempting, as is so frequently done, to cross when a moving train is in sight within a short distance, hoping to make the crossing before the train reached it."—Engstrom v. Canadian Northern, 291 Fed. 736.

Alton Refuses to Recognize Federated Shop Crafts

The Chicago & Alton, in reply to an order by the Labor Board that it allow the Federated Shop Crafts to represent its shopmen, has sent a formal statement to the board declining, in substance, to comply with the order. The officers of the road declare that to return to the previous practice of dealing with the Federated Shop Crafts would open the way for a recurrence of a strike such as the one called by the national shop crafts organization in July, 1922. The reply reviews the dispute in detail. The trouble began, according to the statement, when the striking employees, returning to work, came into a majority over the new workers who had organized a "company association" of shopmen. The Alton claims that a valid agreement was entered into between the management and this association and that no change can be made until the time specified has expired; and that at no time in years have the relations between the management and the shopmen been as cordial as they have been since the formation of the "company association."

Water Glass Shields in Canada

The Board of Railway Commissioners for Canada has amended Clause 36 of its General Order No. 78, by substituting the following: "Water and Lubricator Glass Shields.—Water gage glass mountings on all locomotives must be protected by a strong cage made of aluminum, or brass metal, fitted with heavy reinforced plate glass shields, 3/8 in. thick, with an outlet pipe attached to the bottom of the water gage mounting, which will allow the flow of steam from broken gage glass to escape below the foot plate of the locomotive, or close to the foot place itself.

"These appurtenances must be so located as to insure a correct reading of the level of the water in the boiler at all times, and be in full view of both the engineer and fireman, and the lights so placed that there will be a clear and unobstructed view of the water in the mounting."

This change was made as the result of a petition filed on behalf of the Railway Association of Canada and the Brotherhood of Locomotive Firemen and Enginemen.

Japanese Railways Extend Time Limit on Improvement Program

The Japanese Department of Railways has, in view of the heavy expenses necessitated by the September quake, altered its ten-year construction and repair program recently adopted. The total amount of capital to be spent for the realization of the plan has not been changed, but the time limit on the program has been placed at eleven or twelve years.

The whole construction budget is given at 612,995,000 yen. Of this total 27,404,000 yen is to be set aside for the purchase of locomotives and cars. The credit for repairs and improvement is placed at 676,960,000 yen. Of the figure 150,127,000 yen is to be spent in purchasing locomotives and cars. The purchase of locomotives and cars is to be completed by 1928. The electrification of some trunk lines figures prominently in the altered program. The Department of Railways proposes to spend 81,000,000 yen for the installation of electric plants. Roughly 300,000,000 yen is to be used in replacing old rails.

Canadian National Considering B. & O. Shop Plan

A modified form of the Baltimore & Ohio plan, whereby shop employees co-operate with the management in securing greater efficiency, is likely to be soon given a trial on the Canadian National. Although no decision has yet been reached and the board of directors has not yet had an opportunity of studying the subject, some statements recently made in Winnipeg by Sir Henry Thornton, president of the C. N. R., indicate a trend in that direction.

It had been stated the day previous in a press despatch from Winnipeg that the Baltimore & Ohio plan would be introduced on the Canadian National in the near future, but on the day following Sir Henry denied this report. He added, however: "It is true that there is under consideration and discussion a scheme for co-operative shop working, but this scheme relates to shop practice and working conditions, and has for its object the mutual welfare of both the men and the company. There is no intention on the part of the Canadian National Railway System to part with any of the executive functions which are regarded as essential to the well-being of the property."

Better Railway Service Needed in Brazil

The shortage of rolling stock on the Sorocabana Railway continues to draw protests from shippers along its route, according to Assistant Trade Commissioner Cremer at Rio de Janeiro. The latest is against the poor service given to fruit shippers, who claim that shipments are delayed as much as four days or more, the fruit spoiling in the meantime.

The Sorocabana runs through a fertile and rapidly developing part of the state of São Paulo, but has not been able to keep step with the general march of progress. While locomotives and cars are required, the need for repair shops to keep the present rolling stock in running condition is much greater. The building of a second track on the line between São Paulo and Sorocaba and Avare is also being agitated.

The Central of Brazil proposes to buy 37 locomotives, 12 sleeping cars, 12 passenger cars, 6 steel baggage cars, 6 steel mail cars, 550 freight cars, 50 ventilated box cars for carrying meat and 50 refrigerated box cars for carrying milk and fruit on its broad-gage lines. For the narrow-gage lines, 8 locomotives, 4 sleeping cars and 300 freight cars are proposed. The railroad is reported to be suffering from a shortage of rolling stock, and shippers and travelers are said to complain. Expenditures for rolling stock and new construction have been small during the last year, while receipts have steadily increased.

New Locomotive and Car Shop for Southern

The Southern railway has awarded a contract to the Dwight P. Robinson Company, New York, for the construction of a locomotive and car shop at Birmingham, Ala. The shop will be of the transverse type and will include the following buildings: Erecting shop, 80 ft. by 568 ft.; machine shop, 95 ft. by 468 ft.; boiler shop, 100 ft. by 240 ft.; blacksmith shop, 100 ft. by 260 ft.; forge shop, 30 ft. by 80 ft.; flue shop, 50 ft. by 80 ft.; power house, 80 ft. by 90 ft.; storehouse and office, 55 ft. by 200 ft.; paint shop, 24 ft. by 60 ft.; tank shop, 100 ft. by 158 ft.; firing-up shed, 45 ft. by 100 ft.; wash and locker building, 42 ft. by 128 ft. The erecting shop will have 24 tracks, running across its width, and will be served by an electrically operated transfer table of 250 tons' capacity, traveling its entire length. The erecting shop will also be served by one 150-ton overhead traveling crane and two 15-ton

overhead traveling cranes, each running the full length of the building. The machine shop will be served by two 15-ton cranes, running its full length in a 60-ft. bay. The remaining 35 ft. of the machine shop's width will be divided into two floors, the upper being of the mezzanine order. The boiler shop will be served by a 20-ton crane with a 60-ft. span and the boiler, smith and flue shops will be served by a 20-ton crane with 60-ft. span, operating out of doors in an 800-ft. runway. The cranes will operate from the machine shop into the smith shop and from the erecting shop into the boiler shop. The flue shop will be equipped with electric flue welders and modern flue-handling machinery. The car repair shop will include the following buildings: Steel car repair shop, 108 ft. by 598 ft.; annex machine shop, 51 ft. by 156 ft.; wheel shop, 55 ft. by 125 ft.; dry lumber shed, 41 ft. by 240 ft.; woodworking mill, 100 ft. by 243 ft.; paint house, 25 ft. by 50 ft.; scrap deck, 52 ft. by 400 ft.; reclamation shop, 35 ft. by 60 ft.; wash and locker building, 36 ft. by 90 ft. The steel car shop will include three longitudinal bays. One of these will be served by two 15-ton cranes with 35-ft. span and another by two 20-ton cranes with 40-ft. span, all traveling the entire length of the building. Both the locomotive and car shops will be equipped with new machinery throughout. All will be of the latest design and electrically-driven, each machine being equipped with individual motor, so that no overhead shafting will be needed, and each machine will be run only when it is needed.

Large Extension Program for C. P.

The Canadian Pacific has announced a large program of extension and betterment for the current year. For one section of this program that railway has given an order to the Algoma Steel Company for 50,000 tons of 100-lb. rails, 25,000 tons being for the Western lines and 25,000 tons for the Eastern lines. Additional yard trackage will be constructed between Fort William, Ont., and Port Arthur to provide for the new terminal elevators at the head of the lakes. Considerable extensions will also be made to the terminal tracks at Ignace, Kenora, Outlook and Wynyard. Extensions will also be made to the existing trackage at Vermilion, Murillo, Fort Garry, Austin, Virden, Minnedosa, Johnston, Bredenbury, Antler, Tuxford, Cluny, Kirkpatrick, Kneehill, Milk River, Spring Coulee, New Dayton, Calgary, Coleman, Bank, Temple, Duthil, Nisku, Ottertail, Misko, Salmon Arm, Nutchill, Grind Rod, Okanagan Landing, Beavermouth and Vancouver. Extensions will be made to the enginehouses at Outlook and Wynyard, and the mechanical facilities will also be improved at Medicine Hat. At Winnipeg the power house at the main terminal will be completely replaced by one of the most modern design. The station power plant at Calgary will also be remodeled. A Y. M. C. A. building will be erected at Ignace. In Eastern Canada the company will complete the ballasting of the main line between Montreal and Toronto and between Montreal and Ottawa. There will be 44 miles of rock ballast added between Toronto and Fort William and the laying of 150 miles of new 100-pound rails between the two latter points. Station work will include a new station and divisional headquarters at Schreiber, Ont., and grain handling facilities at Port McNicoll, Ont. Passing tracks, industrial tracks and yard extensions will be built at Chesterville, Tay, Lake Shore Junction, Point au Baril, Cache Bay, White River and Heron Bay in Ontario. To handle heavier locomotives a number of steel bridges will be replaced on the Havelock sub-division.

MEETINGS AND CONVENTIONS

Industrial Purchasing Agents to Meet in Boston

The Tenth Annual International Purchasing Agents' Convention and "Informashow" will be held in Boston during the week of May 19, 1924, under the auspices of the National Association of Purchasing Agents. An attendance of some 3,000 is expected at the convention.

Fuel Association Convention

A Committee on Local Arrangements has been appointed to prepare for the International Railway Fuel Association convention to be held at Chicago, May 26 to 29, inclusive. At its initial meeting, the Hotel Sherman was selected as the headquarters for the convention and tentative plans were made for an exhibit of coal, coke, oil and railway supplies at the hotel during the convention week. The members of the Local Committee are W. H. Harris, president of W. H. Harris & Co., coal and coke dealers, chairman; Percival Hunter, Chicago, Burlington & Quincy; L. J. Joffray, Illinois Central; C. H. Dyson, Baltimore & Ohio; T. Duff Smith, Canadian National; Clarence Mellor, Barco Manufacturing Company; A. W. Clokey, American Arch Company; G. D. Cowin, Bell & Zoller Coal Company; Clark T. Roberts, Hedstrom-Schenck Coal Company, and D. B. Sebastian, formerly president of the Sebastian Coal Company.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 2-5.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que., Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings: first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 2-5, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Tuesday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Truscon Steel Company, Youngstown, Ohio, has leased a building at Erie and St. Clair streets, Chicago, to which it will move its Chicago offices on May 1.

L. H. Welling has been appointed manager of the eastern office of the Graver Corporation, East Chicago, Ind. Mr. Welling's headquarters are at New York City.

Himelblau, Agazim & Co., 30 N. Dearborn street, Chicago, has been appointed Chicago district representative of the Coppus Engineering Corporation, Worcester, Mass.

Herbert Mertz, secretary and sales manager of the Orton-Steinbrenner Company, with headquarters at Chicago, has been elected a director, succeeding H. G. Steinbrenner, resigned.

E. F. Kultchar, district maintenance engineer of the Chicago, Burlington & Quincy, has resigned to join the Ingersoll-Rand Company. Mr. Kultchar will have his headquarters at Chicago, Ill.

The National Malleable Castings Company, Cleveland, O., has changed its corporate name to the National Malleable & Steel Castings Company. There is no change in management or personnel.

Hope E. Scott & Co., Ltd., of 224 St. James street, Montreal, Que., has been appointed representative of the Union Railway Equipment Company, Chicago, in charge of all its Canadian business.

H. E. Hughes, vice-president of the Locomotive Crane Company of America, Champaign, Ill., has been elected president, succeeding Charles Bergan, resigned. He will be succeeded by John Brenza, a director.

J. H. Roberts, until recently vice-president of the Atlas Steel Corporation, has been appointed eastern manager of sales of the Vanadium-Alloys Steel Company, with offices at 143 Liberty street, New York.

Lathrop & Trotter have been appointed Cincinnati representatives of the Conveyors Corporation of America, Chicago. The offices of Lathrop & Trotter are at 733 Union Trust building, Cincinnati, Ohio.

The Okonite Company, Passaic, N. J., has recently opened a branch office at Pittsburgh, Pa., in the First National Bank building. This branch office is in charge of Edward A. Damrau, district manager.

The Sullivan Machinery Company, Chicago, has removed its Birmingham, Ala., office from the Brown Marx building to larger quarters at 2108 Fifth avenue North. G. P. Small is local manager for Alabama.

Richard Trimble, who was secretary-treasurer of the United States Steel Corporation at New York for about 21 years previous to April, 1922, died on February 18 at his home in New York at the age of 66.

Edwin B. Meissner, vice-president of the St. Louis Car Company, with headquarters at St. Louis, Mo., has been elected president and general manager, succeeding John I. Beggs, who has been elected chairman of the board.

Manning, Maxwell & Moore, Inc., has consolidated its Cincinnati, Ohio, and Cleveland offices and has appointed E. H. Merrick, manager of the combined offices, with headquarters in the Huron-Sixth building, Cleveland, Ohio.

C. Garness, mechanical engineer of the American Car & Foundry Company, with headquarters at Chicago, has been appointed supervising engineer of railway car inspection of the Robert W. Hunt Company, with headquarters at Chicago.

The Railway Equipment Company, composed of R. E. Bell and W. H. Reeves, 584 Arcade building, St. Louis, Mo., has been appointed to handle the business of the National Lock Washer Company of Newark, N. J., in southwestern territory.

J. C. Bryan, mechanical assistant to the manager of purchases of the American Short Line Railway Association, has been appointed special engineer in the locomotive headlighting equipment department of the Electric Service Supplies Company, with headquarters at Chicago.

G. P. Rogers, general sales and advertising manager of the Pyrene Manufacturing Company, Newark, N. J., has resigned to become vice-president and director of sales and advertising of the Kant Rust Products Corporation, Rahway, N. J.

Pierce Lewis of the advertising department of the Truscon Steel Company, with headquarters at Detroit, Mich., has been promoted to advertising manager, with headquarters at Youngstown, Ohio, succeeding S. M. Fechheimer, who has resigned.

Walter F. Delaney has been appointed representative of the Hanna Engineering Works, Chicago, manufacturers of Hanna riveting machines, air hoists, sand sifters and I-beam trolleys, with headquarters at 203 Mutual building, Richmond, Virginia.

The Morton Manufacturing Company, Muskegon Heights, Mich., has taken over the sale and distribution of the Robinson patented automatic air hose coupling. This device was described in the December, 1922, number of the *Railway Mechanical Engineer*.

The Paige & Jones Chemical Company, New York, has just completed an addition to its factory building at Hammond, Ind., and is installing considerable new machinery in order to take care of its rapidly increasing business in boiler feed water treatment.

The Pennsylvania Tank Car Company has been consolidated with the Pennsylvania Car Company. The general offices are at Sharon, Pa., and the Pennsylvania Car Company will operate the plants at Sharon, Pa., Kansas City, Kan., and Beaumont, Texas.

B. L. Knowles, manager of the publicity department of the Worthington Pump & Machinery Corporation, New York City, died on February 14 as a result of a cerebral hemorrhage. Mr. Knowles was 45 years old at the time of his death and had spent 28 years with the Worthington Corporation.

James M. Hopkins, chairman of the board of directors of the Ryan Car Company, Chicago, has been elected president, succeeding William M. Ryan, who has resigned, but who will remain as a director and retain his interest in the company. A new chairman of the board will not be elected at present.

J. H. Hackenburg, formerly purchasing agent of the Pressed Steel Car Company, New York, and more recently secretary and treasurer of the Lake Erie Rubber Company, Cleveland, Ohio, has been appointed purchasing agent of the Illinois Car & Manufacturing Company, with headquarters at Hammond, Ind.

J. R. Sexton, who has been in charge of the railroad sales of the H. H. Robertson Company for the past year, has been appointed a district manager with headquarters in Chicago, to succeed the late Hillis F. Hackedorn. Mr. Sexton will remain actively in charge of railroad sales as well as supervise sales in other fields.

E. L. Lord, sales engineer of the San Francisco, Cal., branch of the Electric Storage Battery Company, Philadelphia, Pa., has been assigned to handle the railway sales for that office. He will also supervise the railway business for the Pacific district, which comprises six of the Pacific Coast states and part of Montana.

The Dempster Equipment Company, Inc., Knoxville, Tenn., has been incorporated to rebuild locomotives and freight cars and has purchased 14 acres of land at Knoxville on which the plant will be erected. George R. Dempster is president, Robert P. Thompson is vice-president and treasurer and Thomas G. Shea is secretary.

The National Car Wheel Company, with main plant in West Homestead, Pa., has been sold to the American Brake Shoe & Foundry Company, New York. The annual output of the company is 120,000 tons. J. D. Rhodes, chairman of the board of the National Car Wheel Company and George P. Rhodes, president, have resigned. Joseph B. Terbell has been elected chairman of the National Car Wheel Company. W. F. Cutler, president, F. C. Turner, first vice-president, George M. Judd, secretary, Andrew Muirhead, treasurer, and the other officers of the National Car Wheel Company, remain as formerly.

The Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., has placed a contract with the Hughes-Foulkrod Company and the McClintic-Marshall Company, for the construction of a steel and brick wood mill 350 ft. by 204 ft., with three aisles, each

equipped with traveling cranes. The contract also includes a power house 40 ft. by 98 ft. The approximate cost of these buildings is $200,000. The Mt. Vernon Car Manufacturing Company has just completed a new blacksmith shop 350 ft. by 100 ft., equipped with a traveling crane, arranged for use between the shop and the yard, at an approximate cost of $150,000. In addition this company has completed a repair shed 500 ft. by 100 ft., equipped with double bridge traveling cranes for the repair of freight cars.

Hobart Ames, for nearly 23 years president of the Ames Shovel & Tool Company, Boston, Mass., has resigned and Alfred C. Howell, who was for many years connected with the Bethlehem Steel Company, has been elected as his successor, Mr. Howell having previously been elected a director. Mr. Ames will remain as one of the directors, but intends to devote more of his time to his private interests and to no longer act as the chief executive of the company. Mr. Howell's connection with the steel industry extends over a long period of years, he having served in various responsible positions in Bethlehem, Philadelphia, Cincinnati and Pittsburgh with the Bethlehem, Midvale and Carnegie Steel Companies and for a few years as manager of the steel department of the W. Bingham Company, Cleveland, Ohio.

Paul J. Kalman has been appointed chairman of the board of directors of the Globe Steel Tubes Company, with headquarters at St. Paul, Minn. Frank J. O'Brien, vice-president and general manager, has been elected president, with the same headquarters, to succeed Mr. Kalman and John W. Floto has been promoted to vice-president and general manager. Mr. Kalman was born on April 1, 1879, at New York. He entered railway service in 1897, with the Chicago Great Western. In 1901 he entered the railway supply business as president of the Paul J. Kalman Company, which company later branched out into the reinforced steel and building products business and changed its name to the Kalman Steel Company in 1922. In 1919 he also organized and became president of the Hudson Motor Company of Illinois, and on January 1, 1920, was also elected president of Bliss & Laughlin, Inc., Harvey, Ill. In August, 1922, he became president of the Globe Steel Tubes Company, Chicago, which company at that time took over the business of the Globe Seamless Steel Tubes Company, Milwaukee, Wis. Mr. Kalman is also president of the Kalman Floor Company, which was organized in 1916.

Paul J. Kalman

T. H. Goodnow, superintendent of the car department of the Chicago & North Western and vice-chairman of the Mechanical Division of the American Railway Association, with headquarters at Chicago, has been elected first vice-president of the Ryan Car Company, with headquarters at Chicago. Mr. Goodnow was born on July 22, 1872, at Lathrop, Mo., and entered railway service on July 23, 1890, with the Lake Shore & Michigan Southern (now a part of the New York Central). In November, 1904, he was promoted to general foreman of the car department with headquarters at Air Line Junction, Ohio, which position he held until August, 1906, when he was promoted to division master car builder of the Lake Shore & Michigan Southern, the Chicago, Indiana & Southern, and the Indiana Harbor Belt. In January, 1912, he was appointed general superintendent of shops of Armour & Co., with headquarters at Chicago. He entered the employ of the Chicago & North Western in August, 1912, as assistant superintendent of the car department, with headquarters at Chicago, and was given charge of the car department in February, 1913. In October, 1918, he was appointed to the position of superintendent of the car department, which position he has held until the time of his recent appointment.

TRADE PUBLICATIONS

SOOT BLOWERS.—A four-page illustrated folder, descriptive of the Bayer type S valve-in-head soot blower, has recently been issued by the Bayer Company, St. Louis, Mo.

MOTOR-DRIVEN GRINDER.—A new wide swing floor stand grinder is described and illustrated in Bulletin No. 3016-S, recently issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The wheels of the grinder are of wide spacing (37 in.) to permit grinding of large, bulky castings and many other irregular shaped pieces.

VISES.—A 28-page catalogue, designed particularly for superintendents, master mechanics and shop foremen, has recently been issued by the Charles Parker Company, Meriden, Conn. The catalogue carries in blue print form drawings relative to vise construction and repair parts. Details of the complete Parker line are also given.

CINDER HANDLING PLANT.—Roberts & Schaefer Company, Chicago, has issued a four-page folder illustrating and describing the Junior N. & W. type cinder plant. In addition to a general description there is included a list of 10 advantages claimed for this equipment as regard considerations affecting the construction, operation and maintenance of such plants.

OIL-BURNING EQUIPMENT.—The Mahr Manufacturing Company, Minneapolis, Minn., has recently issued a 64-page illustrated catalogue descriptive of its various types of railroad and industrial oil-burning equipment, including torches, burners, furnaces, ladle heaters, ovens, blowers, etc. W. M. Horner, president of the company, also has written an eight-page brochure entitled, "Co-operation Between the Buyer and Seller," in which the principles and practices governing the sale of Mahrvel products are set forth.

STAMPINGS.—"Heavy Stampings" is the title of a booklet just issued by the Federal Pressed Steel Company, Milwaukee, Wis. The illustrations show numerous examples of how the use of Federal pressed steel parts has resulted in lowering production costs and improving design. Uniformity of product, minimum weight with maximum strength and reduced amount of machining required are some of the advantages emphasized. Pages are also devoted to illustrations and descriptions of Federal disk wheels and bumpers.

POWER REVERSE GEAR.—The Barco Manufacturing Company has recently brought out catalogue No. 94, outlining in a simple and concise way the advantages of the Barco power reverse gear. The arrangement of this gear for either air, steam or hand operation is explained; also the use of a worm and gear to hold the point of cut-off, thus tending to prevent cushioning and creeping. Several illustrations are included showing the gear in phantom and as it is applied to locomotives. A large scale drawing in partial cross section shows all detailed parts of the gear, giving the name of each part.

ELECTRIC TRACTION.—The Westinghouse Electric & Manufacturing Company has recently released a 54-page publication entitled, "A Brief Outline of the Development and Progress of the Electric Railway Industry." This booklet sets forth in a brief and concise manner the history of the electric railway industry, from the installation of the first permanently fixed rails to the production of the powerful electric locomotives of today. A wealth of illustration, including photographs of modern equipment and sketches of the earliest railway apparatus, adds greatly to the interesting character of the publication.

ORDERING FLEXIBLE JOINTS.—The ordering of Barco flexible joints of all kinds is greatly facilitated by means of a four-page catalogue No. 101, recently issued by the Barco Manufacturing Company, Chicago. This catalogue contains illustrations of the various kinds of flexible joints made by this company with designating figures and letters which will enable parts to be ordered with little if any possibility of error. On the last page of the catalogue is a table showing the dimensions of these various parts and the joint sizes. A schedule for ordering automatic smoke box blower fittings is also included on the last page.

PERSONAL MENTION

General

William Martin has been appointed general mechanical inspector of the Missouri Pacific, with headquarters at St. Louis, a newly created position.

F. K. Tutt, superintendent of motive power of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has resigned and his position has been abolished.

O. P. Reese, superintendent of motive power of the Pennsylvania, with headquarters at Chicago, has been appointed assistant general superintendent of motive power, with headquarters at Ft. Wayne, Ind.

R. G. Henley, master mechanic of the Norfolk & Western, with headquarters at Portsmouth, Ohio, has been promoted to assistant to the superintendent of motive power, with headquarters at Roanoke, Va.

G. B. Fravel, superintendent of motive power of the Pennsylvania, with headquarters at Columbus, Ohio, has been appointed assistant general superintendent of motive power, with headquarters at St. Louis, Mo.

S. E. Mitchell, chief draftsman in the mechanical department of the Chicago & Northwestern at Chicago, has been promoted to assistant to the general superintendent of motive power and machinery, with the same headquarters, succeeding W. E. Dunham.

C. Y. Thomas, instructor of apprentices on the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Ia., has been appointed supervisor of apprentices on the Kansas City Southern, with headquarters at Pittsburgh, Kan., a newly created position.

M. C. M. Hatch, assistant to the executive vice-president of the Missouri-Kansas-Texas, with headquarters at St. Louis, Mo., has been promoted to general mechanical superintendent, with headquarters at Dallas, Tex., with jurisdiction over the locomotive and car departments.

J. P. Downs, superintendent of shops of the Missouri Pacific at Sedalia, Mo., has been promoted to assistant mechanical superintendent, with headquarters at Little Rock, Ark., a newly created position. He will have jurisdiction over the St. Louis terminals (east side of river), the Illinois, the Missouri, the Arkansas, the Memphis, the Louisiana and the Central divisions.

W. G. Seibert, general master mechanic of the Missouri Pacific, with headquarters at Kansas City, Mo., has been promoted to assistant mechanical superintendent, with the same headquarters, a newly created position. He will have jurisdiction over the St. Louis terminal (west side of river), the Eastern, the Joplin, the White River, the Kansas City terminal, the Omaha, the Northern Kansas, the Central Kansas, the Colorado, the Wichita and the Southern Kansas divisions. The position of general master mechanic at Kansas City has been abolished.

M. F. Cox, whose promotion to assistant superintendent of machinery of the Louisville & Nashville, with headquarters at Louisville, Ky., was reported in the February *Railway Mechanical Engineer,* was born in Essex county, Virginia. Mr. Cox was first employed by the American Locomotive Company as a special apprentice where he served for a time in each department, including foundry, machinery and erecting shop, boiler shop and blacksmith shop. He was then assigned to the drafting department, in which he continued until he was promoted to mechanical engineer. He also served at the Richmond Locomotive Works in a similar capacity, entering railway service in 1911 as mechanical engineer of the Louisville & Nashville. Mr. Cox continued in this capacity until his promotion to assistant superintendent of machinery.

B. N. Lewis, whose promotion to mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Fond du Lac, Wis., was reported in the February *Railway Mechanical Engineer,* was born on August 22, 1883, at Austin, Minn. He entered railway service in June, 1901, as a machinist and draftsman apprentice on the Minneapolis, St. Paul & Sault Ste. Marie, at Minneapolis, Minn. In July, 1903, he was appointed special apprentice on the Erie at Meadville, Pa., and continued in this position until April, 1906, when he was appointed shop inspector in the Franklin plant of the American Steel Foundries. Mr. Lewis returned to railway service in January, 1908, as a gang foreman on the Erie and in February, 1909, he was appointed roundhouse foreman on the Minneapolis, St. Paul & Sault Ste. Marie. From June, 1911, to May, 1915, Mr. Lewis was engaged in special shop work at Minneapolis and on the latter date was promoted to mechanical valuation engineer. He was promoted to assistant mechanical superintendent in November, 1917, and he held this position until his recent promotion to mechanical superintendent.

Master Mechanics and Road Foremen

O. W. Judd has been appointed master mechanic of the White River division of the Missouri Pacific, with headquarters at Crane, Mo.

H. W. Reinhardt has been appointed master mechanic of the Missouri division of the Missouri Pacific, with headquarters at Poplar Bluff, Mo.

R. H. Hale has been appointed master mechanic of the Alaska Railroad, with headquarters at Anchorage, Alaska, succeeding F. C. Ferrell, who has resigned.

S. N. Woodruff, master mechanic of the Minnesota division of the Minneapolis, St. Paul & Sault Ste. Marie, has retired after 37 years of service with the company.

O. F. Hark, master mechanic of the Norfolk & Western, with headquarters at Bluefield, W. Va., has been transferred to Portsmouth, Ohio, succeeding R. G. Henley.

G. H. Langton has been appointed general master mechanic of the eastern general division of the Chesapeake & Ohio, with headquarters at Clifton Forge, W. Va.

C. R. Kilbury has been appointed master mechanic of the Southern Kansas division of the Missouri Pacific, with headquarters at Coffeyville, Kan., succeeding G. K. Stewart.

L. A. Mitchell has been appointed master mechanic of the East Bay electric division of the Southern Pacific, with headquarters at West Alameda, Cal., succeeding J. H. Lockett, deceased.

T. F. Barton has been appointed general master mechanic of the western general division, except Huntington general shops, of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

J. L. Barry, general foreman of the Norfolk & Western, with headquarters at Columbus, Ohio, has been promoted to master mechanic, with headquarters at Bluefield, W. Va., succeeding O. F. Hark.

J. J. Simmons, road foreman of locomotives of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been appointed acting assistant master mechanic of the Hannibal division, with headquarters at Hannibal, Mo.

A. J. Lewis, general master mechanic of the Missouri-Kansas-Texas of Texas, with headquarters at Denison, Tex., has been appointed master mechanic of the North Texas district, with the same headquarters and the position of general master mechanic has been abolished.

Arthur G. Greenseth has been appointed master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Enderlin, N. D. Mr. Greenseth was born at Clintonville, Wis., January 14, 1888. He entered railroad service in 1903 as a machinist apprentice on the Great Northern at Superior, Wis. In 1908, he was transferred as air brake man in the roundhouse at Devil's Lake, N. D. During 1909 and 1910, he served as a machinist on the A. T. & S. F., the C. G. W., the C. & N. W. and the C. M. & St. P. In March, 1911, he entered the service of the Soo Line as a machinist, and in June, 1913, was promoted to round house foreman, with headquarters at Bismarck, N. D. He was transferred in the same capacity to Thief River Falls, Minn., in

April, 1915. During the World War, he served with the Russian Railway Service Corps in Siberia. Upon being discharged in June, 1919, from the service, he returned to Thief River Falls as roundhouse foreman and served in that capacity until February 1, 1923, when he was transferred to Shoreham. Here he held the position of roundhouse foreman until promoted, February 1, 1924, to his present position.

GEORGE K. STEWART, formerly master mechanic of the Missouri Pacific at Coffeyville, Kan., has been appointed master mechanic of the same road at Atchison, Kan. Mr. Stewart was born at Ottawa, Kan., on August 5, 1869. In 1886, he graduated from the Ottawa high school and entered railroad service on the Santa Fe at Topeka, Kan., as a machinist apprentice, August 1, 1889. Upon the completion of his service as an apprentice in 1893, he worked as a machinist at Ottawa, Kan., until August 10, 1898. At this time he entered the employ of the Missouri Pacific and served as a machinist at Osawatomie, Kan., and Coffeyville from 1898 to 1904, and from 1904 to 1906, respectively. On July 1, 1906, he was promoted to roundhouse foreman at Coffeyville and served in that capacity until September 23, 1909, when he was appointed division foreman, with headquarters at Wichita, Kan. On March 4, 1912, he was appointed master mechanic, with headquarters at Coffeyville. He served in the same capacity from February 12, 1914, to January 10, 1919, at Poplar Bluff, Mo., and in the Desoto back shop. He returned to Coffeyville where he served as master mechanic until his present appointment, February 1, 1924.

G. K. Stewart

Car Department

C. I. MOTT, formerly general car inspector of the Havana Terminal Railway, office estacion Central, has been appointed general car foreman of the Luyano shops of the Havana Central and United Railways of Havana.

E. J. ROBERTSON, superintendent of the car department of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., has had his jurisdiction extended to cover the entire system.

S. O. TAYLOR, chief mechanical inspector of the mechanical division of the American Railway Association, with headquarters at Chicago, has been appointed master car builder of the Missouri Pacific, with headquarters at St. Louis, Mo., a newly created position.

W. E. DUNHAM has been promoted to superintendent of the car department of the Chicago & North Western, with headquarters at Chicago. Mr. Dunham was born at Newark, N. J. He graduated from Cornell University in 1895 and entered railway service in 1896 in the shops of the Chicago, Rock Island & Pacific, at Horton, Kans. He was promoted to draftsman at Chicago in 1898, and in 1901, he was promoted to master mechanic at Dalhart, Tex. Mr. Dunham entered the service of the Chicago & North Western in 1902 as chief draftsman in the mechanical department at Chicago and in 1903, he was promoted to mechanical engineer. He was promoted to master mechanic at Winona, Minn., in 1906, and held this position until 1910, when he was promoted to supervisor in the motive power and car department. He was promoted to assistant to the general superintendent of the motive power and car department in 1917, and in 1921, his title was changed to assistant to the general superintendent of motive power and machinery. Mr. Dunham continued in this position until his recent promotion to superintendent of the car department.

Shop and Enginehouse

J. W. HENDRICKS has been appointed general foreman of the Norfolk & Western, with headquarters at Crewe, Va., succeeding F. R. Forrest.

F. R. FORREST has been appointed general foreman of the Norfolk & Western, with headquarters at Bluefield, W. Va., succeeding F. D. Veazey.

F. D. VEAZEY has been appointed general foreman of the Norfolk & Western, with headquarters at Columbus, Ohio, succeeding J. L. Barry, promoted.

Purchasing and Stores

W. L. OSWALT has been appointed assistant general storekeeper of the Pennsylvania, with headquarters at Altoona.

S. I. GOWLAND, assistant general storekeeper of the Central region of the Pennsylvania, has been transferred to Philadelphia.

O. V. DANIELS, assistant general storekeeper of the Eastern region of the Pennsylvania, has been transferred to Philadelphia, Pa.

J. S. MATTHIAS has been appointed general storekeeper of the Texas & Pacific, with headquarters at Marshall, Texas, succeeding F. S. McClung.

R. C. HARRIS, general storekeeper of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been transferred to Philadelphia, Pa.

W. F. VOGT, works storekeeper of the Pennsylvania, with headquarters at Altoona, Pa., has been promoted to general storekeeper, with the same headquarters.

F. S. MCCLUNG, general storekeeper of the Texas & Pacific, with headquarters at Marshall, Texas, has been promoted to purchasing agent, with headquarters at Dallas, Texas.

C. R. PEDDLE, purchasing agent of the Southwestern region of the Pennsylvania, with headquarters at St. Louis, Mo., has been appointed assistant purchasing agent, with the same headquarters.

W. G. PHELPS, purchasing agent of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed assistant purchasing agent, with the same headquarters.

G. W. SNYDER, general storekeeper of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa., has been appointed assistant to the stores manager, with the same headquarters.

C. W. KINNEAR, general storekeeper of the Northwestern region of the Pennsylvania, with headquarters at Chicago, has been appointed assistant general storekeeper, with headquarters at Altoona, Pa.

W. W. MORRIS, purchasing agent of the Northwestern region of the Pennsylvania, with headquarters at Chicago, has been appointed assistant purchasing agent, with headquarters at Philadelphia, Pa.

C. E. WALSH, assistant purchasing agent of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed assistant purchasing agent, with headquarters at Philadelphia, Pa.

A. E. OWEN has been promoted to assistant purchasing agent of the Pennsylvania, with headquarters at Chicago. Mr. Owen was born on March 27, 1880, at Camden, N. J. He entered railway service in April, 1896, in the department of the auditor of passenger receipts of the Pennsylvania at Philadelphia. He was transferred to the purchasing department in June, 1899, and subsequently held various positions in that department. In 1914 he was detailed to represent the purchasing department with Messrs. Gibbs and Hill, consulting electrical engineers, who were constructing the Philadelphia, Paoli and Chestnut Hill electrification. In 1917, Mr. Owen was appointed chairman of a committee which took over the management and supplying of commissaries of labor camps on the Pennsylvania lines east of Pittsburgh and Buffalo, and in 1919 he was promoted to equipment agent. He was appointed assistant to the purchasing agent of the Northwestern region, with headquarters at Chicago, in March, 1920, and continued in that position until his recent promotion to assistant purchasing agent.

Railway Mechanical Engineer

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Can You Answer These Questions?

What is the division of your total expenditure for freight car repairs between cars of home and foreign ownership? How much of the total expenditure for repairs to home cars were you directly responsible for, and how much of it did you pay in settlement of M. C. B. bills? For how much of your expenditures for repairs to foreign cars were you reimbursed? Did the amount of your M. C. B. bills against other lines fully reimburse you for the work done? How much profit or loss did you take on these operations? Car for car, do you notice any difference in the amount of the bills you pay for different series of the same type? Without answers to these questions, can you intelligently determine the value of your different designs? Or can you tell whether you are collecting all that is coming to you for billable charges? Or can you determine with any degree of accuracy when and how far you should go in restoring any series of your equipment by heavy repairs, having in mind the reduction in current repair expenditures to be effected thereby? In other words, are not answers to these questions really essential as the basis for a sound policy of car maintenance and purchases?

Car Repair Competition Closes May 1

The competition on the elimination of waste at outlying car repair points closes May 1. The competition announcement on page 138 of the March *Railway Mechanical Engineer* gave a fair outline of some of the conditions that can be found at outlying car repair points. It brought out the worst conditions and had very little to say about the more efficient points. Perhaps the methods used on your road are getting excellent results. If they are, tell us how it is being done and see that the article is mailed to 30 Church street, New York, on or before the closing date. Prizes of $50 and $35 are being offered for the first and second best articles, respectively. The judges will base their decision on the value and practicability of the methods described and not on literary merit. Not winning a prize is no occasion to be discouraged for if your article contains some good ideas or suggestions, there is a possibility of its being published, in which case it will be paid for at the usual space rates. Keep in mind the closing date—May 1.

Inspection Trips to Railroad Shops

The practice among railroad men of making occasional visits of inspection to other roads is becoming quite general. For the shop man, these visits are well worth the time and the effort that they require. Naturally, the newer terminal installations attract the most attention. It is at these points the shop man expects to get the most information relative to new operating methods and shop layouts. It is a mistake, however, not to visit the older shops and terminals. No matter how interesting the newer terminals may be, representing, as they usually do, the latest developments in scheduling systems, methods of material handling, machine tools, drop pits and fuel handling equipment, it is just as profitable to visit the older shops to see how the difficulties of utilizing old equipment and antiquated shop layouts are being overcome. One is reminded of the old saying that fine birds do not always wear fine feathers. It is a notable fact that the most ingenious ideas for shop kinks have originated in the older shops and it has been a rare occasion where a trip through an old railroad shop has not revealed something unusual in operating methods, special facilities, arrangement of machine tools or in erecting work.

Training for Leadership

So far as the rank-and-file are concerned, the foreman or subordinate supervisory officer with whom they come directly in contact represents the management, and they judge the management by these men. The foreman must be in a position to interpret the policies and aims of the management to the men and at the same time must bring the needs of the men to the management, or rather, interpret the men to the management. To do this successfully, and at the same time secure the greatest possible efficiency from the organization, the foreman must be a real leader and constructive force.

Men are ordinarily promoted to the position of foremen because they have proved to be master workmen and have personalities which command respect and indicate leadership ability. Unfortunately no definite training is given these men in the art of leadership. It is rather assumed that a man's experience in the ranks and his ability as a master craftsman have fitted him for leading men. This seems rather strange when we stop to think that men are required to study intensively for long periods to perfect themselves for comparatively simple vocations. A professional man must spend years in such training, and yet it is doubtful if any profession is much more difficult and intricate than that of successfully leading men.

It is, of course, true that our industrial and transportation agencies have grown in size so rapidly that the importance of leadership has not been thoroughly recognized, or has been lost sight of because of this rapid growth. The lack of proper leadership, however, has brought about exceedingly serious complications in our organizations—questions so grave and so great that they are pressing hard for a solution. Fortunately there has been a growing conception in recent years of this need, and while it is not yet generally fully recognized, various steps are being taken to improve conditions. We would direct attention, for instance, to the formation of foremen's clubs, designed particularly to promote the study and discussion of the fundamental principles of leadership and their application to specific problems. There are several varieties of such clubs, from those which are highly organized, with ambitious programs, to those which meet at intervals in a more or less informal way.

Then, too, there is the tendency for the ranking local officer to hold more frequent and more comprehensive staff meetings. There has also been a noticeable tendency in recent years for a larger degree of study by the foremen of special courses adapted to their needs and for a wider reading of current periodicals.

This is a good beginning, but the matter of successful leadership is so complicated, and it is becoming so much better understood, that it would seem that department heads and managements should take a larger degree of interest in helping their foremen and subordinate officers to get a larger knowledge and training in this respect than is ordinarily possible. It must be recognized that real leadership not only demands certain specific qualifications on the part of the individual, but that much study and training are required to perfect it, as is true in the case of any other profession. Leadership is not a vocation—it is an art. It is becoming more and more generally recognized that the foremen and subordinate officers hold the key to the solution of the labor problem. Why not then face up to the situation and assist these men in every way possible to perfect themselves in leadership, and to back them up in such a way as to make their personalities and efforts count for the very most?

How to Avoid Government Ownership

In addressing the American Railway Engineering Association at its recent meeting in Chicago, Sir Henry Thornton, chairman and president of the Canadian National Railways, spoke of the relations of the railways to the state. In concluding he made this statement: "The fate of our great railway undertakings will depend to a very large degree upon the sagacity, the justice and statesmanship of those who administer these properties during the present uncertain period, when the psychology of man is undergoing a rapid change and development throughout the civilized world." The continued prosperity of a nation is so intimately interwoven and dependent upon the extent and strength of its transportation systems, that in the light of Sir Henry Thornton's statement, a tremendous responsibility rests upon the shoulders of those who are in charge of their direction. Sir Henry also indicated that, "State ownership is only practicable * * * in the event of complete divorcement from influences other than those which have for their object the welfare of the community."

The evils of government ownership of railways, as they have been experienced in most countries, are such that this country and those in charge of the railroads will do well to maintain conditions which will make it possible to promote and continue private ownership. What are the cardinal principles essential to the existence of a railway as a private enterprise? Sir Henry indicated that there were three such principles: (1) It must maintain solvency and meet its financial obligations; (2) it must furnish adequate transportation at reasonable rates to the public; (3) it must pay to its employees that wage which under reasonable conditions will permit them to live in decency and comfort, under sanitary conditions, and to educate and bring up their children as self-respecting members of society.

If any one of these essentials is disregarded for an extended length of time it may bring about government ownership, while if more than one of them is disregarded, government ownership is likely to come about quickly. In another part of his address, Sir Henry indicated that there was still a fourth factor, which is social in character. That is the increasing spirit of discontent and dissatisfaction in the masses of the public in all countries with respect to the distribution of wealth, which must not be ignored by those who wish to retain in private hands those forms of industry which vitally affect the welfare of the community.

Sir Henry Thornton, because of his wide experience in railroading in this country, Great Britain and Canada, is well qualified to discuss this question of private and government ownership. The railroad labor unions in general have been leaning toward government ownership in this country, although it is extremely doubtful whether any considerable number of the members are following their leaders in this respect; as a matter of fact, some of the labor leaders have come out openly and very strongly against government ownership. If this country, however, is to continue the advantages of private initiative and ownership, the essentials laid down by Sir Henry Thornton should be given the most careful consideration and every effort should be made to educate railroad employees and the public at large to the real facts about the railroads and the advantages of private ownership.

What Do You Get From Your New Power?

The tests made last December by the Lehigh Valley on its three-cylinder Mountain type locomotive for fast freight service are noteworthy not alone because of the novelty of the design of the locomotive and the attractive results shown, but as well because of the infrequency with which the railroads generally subject the merits of their new power to any such examination. Even on the most conservative of railroads some progress or at least some change, is shown in motive power development with successive orders of new locomotives. Some of these modifications are purely mechanical for the purpose of facilitating or decreasing the cost of maintenance. Other important changes, however, are made with the purpose of improving the performance in some respect. With the present almost complete inability of the average department head to arrive at any measure of performance of one class of power as compared with another by statistical analysis, the only possible way of ever determining whether or not the new class of power is adequately fulfilling the expectations of its designer is by means of road tests, simple or elaborate as circumstances will permit or as the nature of the comparison made requires. Without such tests, the only evidence of the value of the latest order of locomotives to be placed in service is such effect as these locomotives may have on the general average of performance results, which may be negligible because of the relatively small number of locomotives in question, or may be completely offset by adverse conditions developing elsewhere in the service. In the formulation of sound policies of locomotive acquirements, the exercise of the highest degree of intelligence is required. Intelligence, however, implies knowledge, without which it is of little value. Whatever it may cost, the price of adequate knowledge is an investment on which a big return is sure to be obtained through the elimination of costly mistakes and the speed with which full advantage may be taken of profitable developments.

Possibilities in X-Ray Inspection

To the uninitiated, the X-ray is a sort of mysterious thing far beyond the scope of ordinary man. Based on a seemingly complicated theory, its development and application to industry has been largely relegated to the scientist and his laboratory. It is a difficult matter for a practical shop man to understand how a study of atoms, electrons and various other minute invisibilities is going to be of any particular benefit to his business. It will be of interest, however, to know that by the use of the X-ray, metallurgists have been constantly improving the quality of forgings and castings. X-ray studies and examinations of the crystalline structure have already brought about a considerable improvement in the properties of old alloys and have greatly assisted in developing new alloys or heat treatments to satisfy new requirements.

In a recent address before the New York Chapter of the

American Society for Steel Treating, Dr. Ancel St. John brought out the fact that improvements in the quality of materials permit a lower factor of safety. This was illustrated by citing some results of investigation work by the Ordnance Department at Watertown Arsenal. Reduction of weight is an important factor in ordnance design and for this reason a low factor of safety is used wherever possible. Of course, this means that the materials used must be of exceptionally high quality, free from fissures or blow holes that sometimes develop in the process of manufacture. In order to obtain a thorough inspection of all forgings or castings, a portable X-ray machine has been built that has a penetrating capacity to approximately six inches. This method of inspection has enabled the designer of ordnance equipment to reduce the factor of safety in many cases as low as 1 and 1.5.

The nature of the application of such a low factor of safety in other industries, outside of ordnance work, is a matter of conjecture at the present time. However, there is a possibility of X-ray inspection becoming an important factor in locomotive construction.

At present, locomotives are designed with a sufficiently high factor of safety to allow for any probable defects in material or workmanship. This factor varies anywhere from 3 to 5 according to the nature of the load. Naturally, a high factor of safety means increased weight. There is also to be considered the fact that parts having a large cross-sectional area occupy space that is gradually becoming more valuable as the size of locomotives increase and clearance limits remain stationary.

X-ray, or radiographic, examination should also prove valuable for boiler inspection, especially in the manufacture and purchase of new material. A single radiograph can give more information as to the extent and character of fissures and inclusions than any number of sample sections, and does so without damaging the specimen.

The work of development has not yet progressed far enough to bring the cost of radiographic examinations within practical limits for general industrial application. The penetrating power of the X-ray has only been known to science for approximately six years, and judging by its development during that time, it should not be long until it can be profitably used by industries not directly engaged in the manufacture of iron and steel. In the case of the railroads, where the question of increased capacity and human safety are always of prime importance, the utilization of the X-ray may well be given early consideration.

New Books

TRADE STANDARDS. *Brochure resulting from a research by executives and engineers associated with the Compressed Air Society. Thirty-nine pages, 6 in. by 9 in. five illustrations, paper bound. Published by the Compressed Air Society, 50 Church street, New York.*

The Compressed Air Society has published this brochure with the belief that there is a need for such an authoritative work of reference and that compressed air engineers, and users as well as manufacturers of air compressors, will appreciate such a step toward the establishment of definite trade standards in the industry. The work embodies the result of extended study and research on the part of the executives and engineers associated with the members of the Compressed Air Society. It embraces the nomenclature and terminology relating to air compressors and their operations; a history of the development of speeds of air compressors; an explanation of capacities and pressures; instructions for the installation and care of air compressors with illustrations of devices suggested for cleaning the intake air; recommendations for the lubrication of air compressing machines and the cleaning of air receiver piping, and a description of the low pressure nozzle test recommended by the society.

The compressed air industry has been in need of this sort of reference book for a number of years. It should be the forerunner of a more elaborate and complete book covering the various detailed phases of the industry. This brochure also contains a partial list of the application of compressed air which can readily be expanded by illustrations and descriptions. Its worth can be increased by annual revisions and additions of information commensurate with the growth of the industry.

MANUAL OF INSTRUCTION FOR WELDING OPERATORS. *Published by The Welding Engineer, Chicago, Ill. 17 pages, 6 in. by 9 in.*

This pamphlet has been prepared primarily for the convenience of welding schools and welding departments where the Welding Encyclopedia is used as a text. A review of the encyclopedia was published in the November, 1923, number of the *Railway Mechanical Engineer.* The manual contains a complete set of outlines of lessons, exercises and examinations for the training of oxy-acetylene welders and electric arc welders. All of the material contained therein has been reproduced directly from the encyclopedia, which for purposes of instruction, provides a more convenient form for handling.

A CENTURY OF LOCOMOTIVE BUILDING BY ROBERT STEPHENSON & COMPANY, 1823-1923. *By J. G. H. Warren. Published by Andrew Reid & Co., Ltd., Akenside Hill, New-Castle-upon-Tyne, England. 461 pages with over 300 illustrations from original portraits, documents, drawings, engravings, letters, etc., and several plates; size 8 in. by 11 in. Bound in Cloth. Price 28 shillings.*

Invariably the history of a great industry is the biography of great men. For this reason it is not strange that an account of a hundred years' growth and achievement in locomotive building by Robert Stephenson & Company should be principally an account of the life of George Stephenson and his son, Robert. Twenty-two of the thirty chapters are concerned with the development of the locomotive during the classical period, which may be said to have terminated at the death of Robert Stephenson.

The author has told the story in a commendable manner. Based on original documents still in the possession of the descendants of the two original partners, Edward Pease and George Stephenson, and illustrated with numerous reproductions in fac-simile of original manuscripts, he has produced a book that is intensely interesting. These have been supplemented by contemporary documents and drawings from English, French, German, Russian and American sources. Some of the most important are published in this book for the first time.

The greater part of the book deals with the evolution of the locomotive in its early stages. It brings out in a striking manner the influence that the roadway and track had on the mechanical development. The fact that the elder Stephenson made a remarkable record as a civil engineer and devoted a large part of his time to such work as the construction of the Liverpool and Manchester and various other lines, was given careful consideration by the author in showing the effect this training had on the early growth of the locomotive. It was George Stephenson who advocated the wrought iron rail in preference to cast iron in order to carry a heavier locomotive. The development of the "Rocket" and its success at the Rainhill trials is told in an interesting and instructive manner. That the work of the Stephensons was not without its trials and tribulations is well brought out in the account of the various controversies as to the relative merits of the different methods of locomotion advocated at that time.

The victory of the "Rocket" at these trials was a fortunate

event, for it permitted further experimentation along the lines established by the winning locomotive. As it so happened, Robert Stephenson & Company was enabled to go ahead with considerable experimental work in which it tried out both the four and six-wheel types and also conducted performance tests to determine drawbar pull and cost of operation.

It is interesting to read of the period of separation of the American from the English design. A number of locomotives were shipped by Robert Stephenson & Company to America, the types following closely those that were being developed in England at that time. It was the result of a careful study of one of the first engines of the "Planet" type sent to America that Matthias W. Baldwin built the locomotive known as "Old Ironsides." The unfavorable conditions under which locomotives were required to operate in this country soon led to the development of the engine truck and cow catcher. Cast iron wheels were substituted for the wooden ones and cast iron crank axles were found to give excellent service. Regulator and steam pipes were fitted outside the boiler and a bell was also added to the equipment.

The book contains a wealth of information not only to the general reader and student of railway history, but also to the designer of locomotives.

What Our Readers Think

Who Can Answer This Question?

Denver, Colo.

To the Editor:

We are having considerable trouble with loose crown brasses. Our boxes are slotted out to a radius from shoulder to shoulder, then the crown brass is turned on a special mandrel to the required radius, after which it is laid off with special calipers touching in the back and both shoulders, with about 1/4 in. tip to give from 8 to 18 tons pressure. We then take the boxes to the babbitt shop where they are heated to apply the lateral side plates. But whether there is not enough tonnage on the crown brass or whether they get too hot at the babbitt fire, we have not been able to determine. If some of the readers of the *Railway Mechanical Engineer* can give the cause of the troubles I will be very thankful.

Matthew Devlin.

[The following letter was received in response to a request for an answer to this question. We shall welcome other answers from our readers.—Editor.]

A Discussion of Loose Crown Brasses

Greenville, Pa.

To the Editor:

The cause of loose crown brass trouble may be partially determined by assuming the existence of certain conditions not definitely described in Mr. Devlin's letter.

If we first assume that the driving boxes receiving the brasses at 8 tons pressure, are of cast iron and suitable for journals of about seven inches in diameter and those receiving brasses at 18 tons pressure are made of cast steel and designed for journals of eight inches or nine inches in diameter, we may conclude that the pressures used do not vary greatly from the practice of many other shops.

A second condition that is not mentioned in the letter is the degree of looseness existing in the fit between the box and the brass. Usually brasses show indications of looseness by grease working out from between the brass and the box. Sometimes after a brass is removed from the journal, it will sound sufficiently loose when tapped on the inner surface with a hammer, to justify removal. However, in order to answer the question completely, one should know if these conditions applied, or whether the brasses were permitted to become loose enough to allow their removal from the box with little or no force before it was considered necessary to renew them.

The term "loose driving box brass" covers a wide range of conditions, as cited in the preceding paragraph. While we do not know the exact limitations required by the Interstate Commerce Commission, we do know that the intent of Rule 137, relative to the inspection and testing of locomotives, is clearly expressed in the first sentence; namely, "Driving boxes shall be maintained in a safe and suitable condition for service. Broken and loose bearings shall be renewed. Not more than one shim may be used between the box and bearing."

Although grease may work out around a brass at its bearing within the driving box, there is no reason to consider that it is unsafe so long as the brass is properly secured in the box by plugs, flange or other means for retaining it in place. Again, as long as the condition of the fit does not in any way tend to impair the proper operation of the driving box, it can hardly be said that the brass is not in a suitable condition for service. This is evidenced by the fact that driving boxes with slip fit brasses—that is, brasses that may be removed without taking the box from its pedestals—have been in use for some time. The slip fit crown brasses used in boxes of this type do not give any more trouble from loosening than do the pressed in crown brasses used in another design of driving box. In this comparison the locomotives are supposed to be the same, operating under identical conditions.

If the boxes in question are of the type just described, the pressure stated should be sufficient. The cause of the looseness is undoubtedly other than lack of sufficient fit allowance in applying the brass, provided the machining of both pieces has been properly performed.

It will be found that all boxes are not carefully machined in the circular recess owing to a change of tools being made at a point from one to two inches from the shoulder. This frequently leaves a high place on the machine surface that indicates a false fit because of the force necessary to press the brass into the improperly machined recess.

Mr. Devlin does not state to what temperature the box is heated preparatory to pouring the hub plate. If the box was heated sufficiently to discolor the metal to a blue or blue-green shade, the temperature of the box and brass would be about 600 deg. F. The expansion of brass is very nearly one and one-half times that of cast iron or cast steel. If the brass is 10 in. in diameter, then the circumferential distance from shoulder to shoulder of the box will be about 19 in. The difference of expansion in the two metals at 600 deg. F. will make the brass measure on the circumference 1/32 in. larger than the recess of the box measured in a like manner. One of two things must happen in this case; either the box must spring or open sufficiently to allow for the expansion of the brass, or the brass must compress and accommodate itself to the resistance of the box with consequent looseness when both become cold.

Driving box brasses that are forced in at excessive pressures will sometimes spread the boxes 1/8 in. or 1/4 in. at the bottom. If a brass applied in this manner becomes excessively heated in service and requires renewal, the cellar is usually found to be very tight in the box. When the cellar is removed, the box will be found small at the bottom, which indicates that the strain imposed in applying the brass was sufficient to compress the brass when heated.

If the brasses mentioned by Mr. Devlin are found to be loose after applying the hub plate and before being put into service, the condition may be due to preheating the box. This may be eliminated by discontinuing the practice of preheating, which is not necessary. Either brass or babbitt may be poured without preheating the box.

F. M. A'Hearn.

L. V. Tests of Three-Cylinder Locomotive

Fast Movement of Heavy Trains Produced with Low Fuel Consumption and High Boiler Efficiency

On December 29 and 30, 1923, road tests were run on Lehigh Valley Locomotive No. 5000, a three-cylinder Mountain type for freight service, built by the American Locomotive Company, to measure the fuel and water performance and the horsepower developed. The first 45 miles of the run on December 29 were steadily ascending with maximum grades slightly greater than 21 ft. per mile and an overall difference of elevation of 340 ft., followed by a 20.5-ft. descent for about 10 miles. The run in the opposite direction on December 30, started with 29 miles of slightly rolling grade followed by 14 miles of continuous ascent at the rate of 20.5 ft. per mile and 34 miles of rolling descent for the latter part of which continuous grades of 21.1 ft. prevail. With trains averaging 4,274 tons, the coal consumption averaged 62.7 lb. per 1,000 gross ton miles. The indicator results showed a water consumption per indicated horsepower-hour, including the auxiliaries, of 20.36 lb., a coal consumption per indicated horsepower-hour, including auxiliaries, of 2.72 lb., and a maximum indicated horsepower exceeded 3,000. For the two runs, the overall efficiency of the boiler averaged 77.58 per cent.

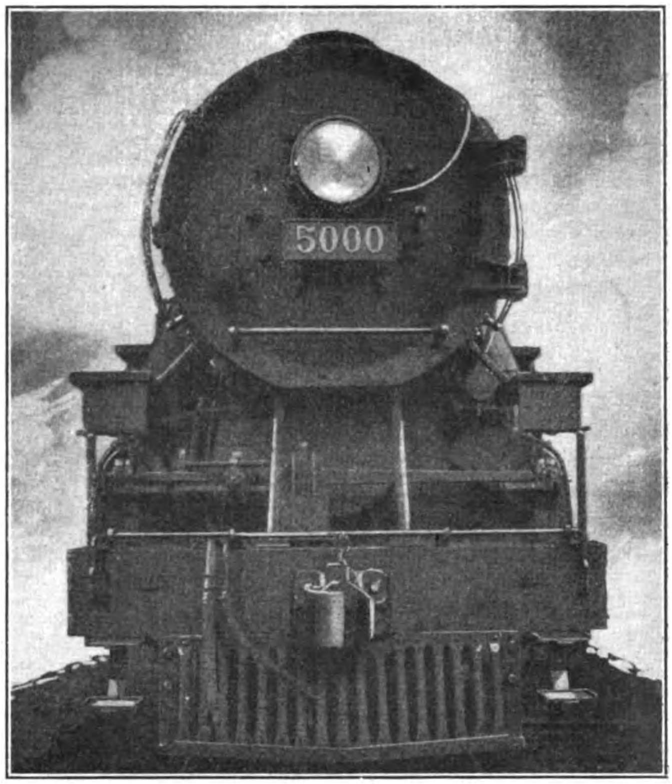
The locomotive was placed in operation on the Lehigh Valley in October, 1923. It was designed following the experience of the builders with a converted two-cylinder 4-8-2 type fast freight locomotive, which was placed in service with three cylinders on the New York Central in 1922.*

The Lehigh Valley locomotive is a complete new design. It has, however, the same size cylinders and driving wheels as the converted New York Central locomotive. The boiler, on the other hand, is built with a combustion chamber and fitted with a Type A, instead of the Type E, superheater, and unlike the New York Central locomotive, the main rod of the inside cylinder is connected to the second pair of driving wheels, while the outside main rods are coupled to the third pair of wheels. The principal dimensions and proportions of the Lehigh Valley locomotive are given in one of the tables.

The Road Tests

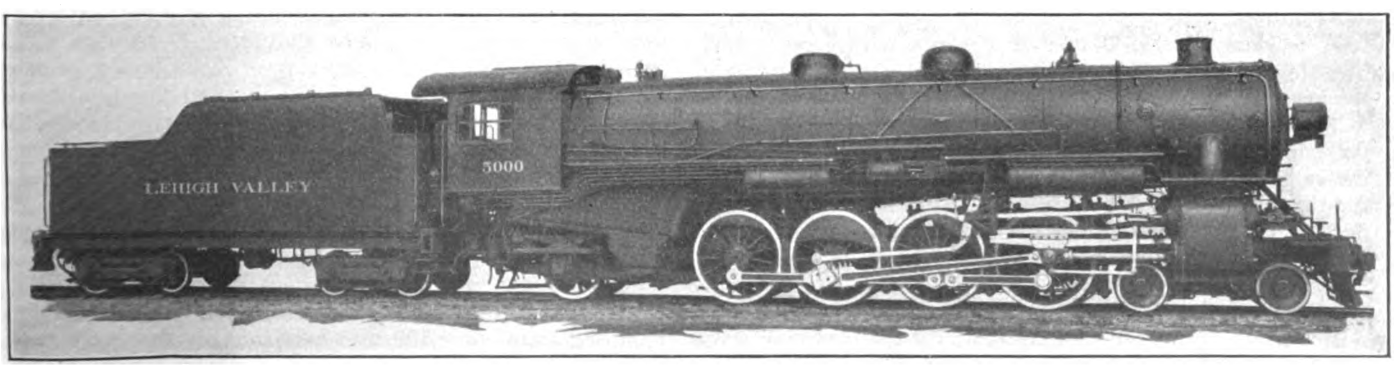
Prior to the tests, the locomotive was taken into the East Buffalo shops of the Lehigh Valley and equipped with the necessary apparatus for measuring the fuel and water and indicating the cylinders. The tank was fitted with gage glasses at the corners for measuring the water, and was calibrated by weighing out the water in a barrel mounted on a platform scale. A drop bottom coal box was placed in the tender for measuring the coal, the capacity of the box having been checked by dumping and weighing the contents a number of times. Steam temperatures were taken by thermometers placed in the left steam pipe close to the steam chest and in the exhaust passage, and pressure gages were applied to both the saturated and the superheated sides of the superheater header. The boiler pressure was shown on a recording steam gage placed so that it could be read from the indicator box. A speed recorder was placed in the cab and a revolution counter used for checking purposes. Indicators applied to the three cylinders completed the equipment.

The locomotive was fired with mine run bituminous coal,



Front End of the Three-Cylinder Locomotive, Showing the Inside Valve Motion

* This locomotive originally had 28-in. by 28-in. cylinders. The conversion consisted of applying three 25-in. by 28-in. cylinders, a Type E superheater, an Elesco feedwater heater and an Elvin stoker. For a description of this locomotive see the *Railway Mechanical Engineer* for November, 1923, page 743.



Lehigh Valley Three-Cylinder Simple Mountain Type Locomotive for Freight Service

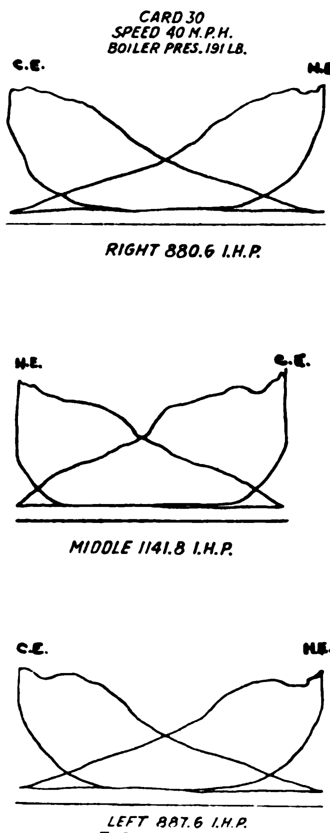
with average heat value of 12,656 B. t. u. as fired, with the following proximate analysis:

Moisture	2.76 per cent
Fixed carbon	51.73 per cent
Volatile	33.59 per cent
Ash	11.99 per cent
Sulphur, separately determined....	2.46 per cent

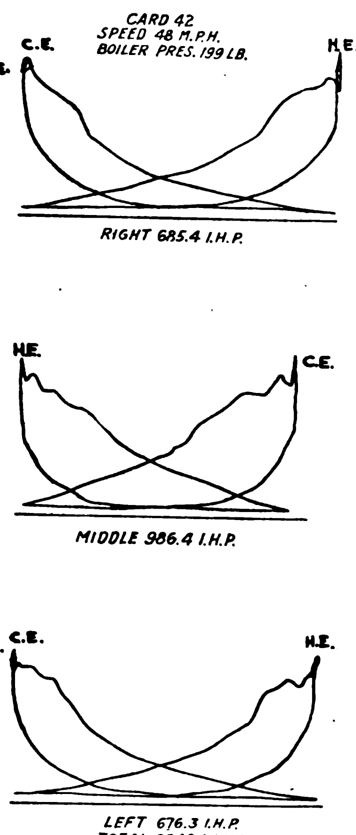
The weather was clear and the temperature averaged 37.5 deg. F.

A summary of the test data and the results of the two runs made on December 29 and 30 are shown in one of the tables. The first of these runs was made from Tifft Farm to Caledonia, where the necessity of setting out a car for a hot box terminated the tests. This is a distance of 59.4 miles, of which 56.4 miles required the working of the locomotive, and the remaining three miles were drifted. On December 30 a run was made from Manchester to Depew, a trip on which the train drifted for 13 miles from mile post 425 to Depew. In the test results, no deductions have been made from the fuel and water consumption for this drifting period so that the entire fuel and water consumption is charged against the actual working time of the locomotive.

The average cut-off at which the locomotive worked on this run was 53 per cent and the fuel consumption was 2.56 lb. per indicated horsepower-hour, in which is included the coal required to operate the stoker and air pumps, which used saturated steam, as well as that lost at the pops. In the table, an estimate is given of the coal consumption per indicated horsepower-hour, deducting the amount required for the operation of the auxiliaries. In estimating this deduction care was taken to avoid overstating and rather to understate the amount of the deduction.



This Card Was Taken on December 29; Speed 40 M.P.H.

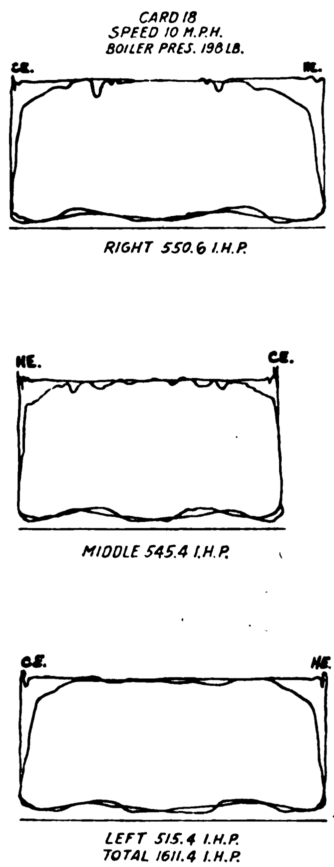


This Card Was Taken on December 30; Speed 48 M.P.H.

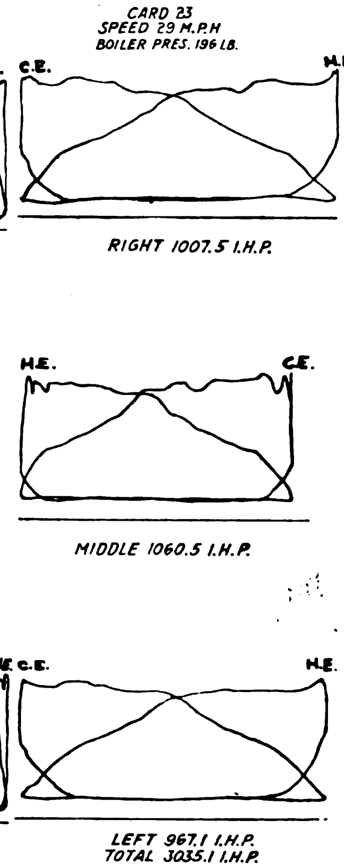
General Performance of the Locomotive

No dynamometer car was available for the foregoing tests, and though no record is available of the drawbar pull of the locomotive and its exact performance while starting, it was generally observed that the train started smoothly and quickly, with a noticeable absence of jerks. Its riding qualities are said to be exceptionally smooth and free from lurching and vibration at high speeds.

The freight power on the Buffalo division, where the test runs were made, with which the performance of the three-cylinder Mountain type locomotive may be compared, is largely of the Mikado type, with a few locomotives of the 2-10-2 type. The lighter Mikados used on this division have a starting tractive force of 59,000 lb. for the locomotive alone and 69,000 lb. for the locomotive and the booster. The tonnage rating of these locomotives over this division is 3,000 and 3,500 tons, respectively, for the two conditions named. These locomotives have two cylinders, 27 in. by 30 in., 63-in. driving wheels, and carry 200 lb. boiler pressure. The weight in working order is 237,900 lb. on the drivers and 325,200 lb. total for the engine. The heavier Mikado locomotives have a tractive force of 63,000 lb. for the engine alone and 73,000 lb. for the engine and booster. These locomotives have a tonnage rating of 3,250 and 3,750 tons, respectively. They have cylinders 27 in. by 32 in., 63-in. driving wheels and also carry 200 lb. boiler pressure. The weight on drivers is 235,500 lb., and the total weight of the engine is 318,000 lb. The Santa Fe type locomotives have a tractive force of 72,600 lb. without booster and a rating of 3,500 tons. These engines have 29-in. by 32-in. cylinders, 63-in. driving wheels and carry 200 lb. boiler pressure. The weight on drivers is 289,000 lb. and the total weight of the engine, 370,000 lb.



Low Speed, Long Stroke Indicator Card Taken on December 29



Indicator Card, Showing Maximum Horsepower, Taken on December 29

The three-cylinder Mountain type locomotive, with a tractive force of 64,700 lb., has proved itself capable of handling trains of 4,500 tons over this division and has received that tonnage rating. It has moved trains of 4,000 tons over the division, a distance of 94 miles, in 4 hrs.

30 min., as compared with running time of 5 hrs. 40 min. for the heavier of the two Mikado type locomotives handling a train of 3,000 tons, and 6 hrs. for the Santa Fe type locomotive with a train of 3,500 tons.

Performance on Grades

Following the tests on the Buffalo division, engine No. 5000 was transferred to a 145-mile run between Sayre, Pa., and Lehighton, to determine whether the locomotive could operate milk trains over the mountain, weighing approximately 1,200 tons, which were regularly handled by Pacific type locomotives, double-headed.

Eastbound, the first 85 miles from Sayre is practically level, with a total decrease in elevation of slightly over 200 ft. to Pittston Junction, just east of Coxton. From this point, the grade is steadily ascending to Glen Summit Springs, a distance of 24 miles, of which 13 miles has a ruling grade of 61.5 ft. per mile. From Glen Summit Springs the grade descends to Lehighton with a total difference in elevation of 1,270 ft. From Lehighton west, the first 36 miles is ascending. The last 9 miles of the ascent is at the rate of 63 or more feet per mile, with a comparatively short ruling grade of 69 ft. per mile. From Glen Summit Springs to Pittston Junction, the total decrease in elevation is approximately 1,175 ft.

Table of Dimensions, Weights and Proportions of Lehigh Valley Locomotive No. 5000

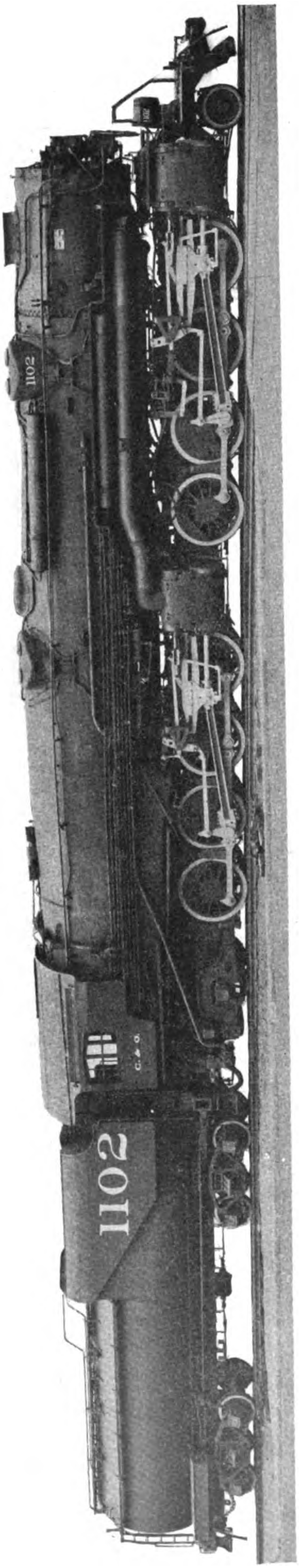
Builder	American Loco. Co.
Type of locomotive	4-8-2
Service	Freight
Cylinders, number, diameter and stroke	3—25 in. by 28 in.
Valve gear, type	Walschaert
Weights in working order:	
On drivers	246,500 lb.
On front truck	66,000 lb.
On trailing truck	56,500 lb.
Total engine	369,000 lb.
Tender	201,000 lb.
Wheel bases:	
Driving	18 ft.
Rigid	18 ft.
Total engine	41 ft. 2 in.
Total engine and tender	77 ft. 8 in.
Driving wheels, diameter outside tires	69 in.
Boiler:	
Type	Conical
Steam pressure	200 lb.
Fuel	Bitu. coal
Diameter, first ring, inside	82½ in.
Firebox, length and width	126⅛ in. by 96¼ in.
Combustion chamber length	52 in.
Tubes, number and diameter	230—2¼ in.
Flues, number and diameter	50—5½ in.
Length over tube sheets	21 ft.
Internal area through tubes and flues	10 sq. ft.
Grate area	84.3 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	392 sq. ft.
Tubes	2,832 sq. ft.
Flues	1,505 sq. ft.
Total evaporative	4,729 sq. ft.
Superheating	1,249 sq. ft.
Comb. evaporative and superheating	5,978 sq. ft.
Special equipment:	
Brick arch	Security
Superheater	Type A
Stoker	Elvin
General data estimated:	
Rated tractive force, 85 per cent	64,700 lb.
Cylinder horsepower (Cole)	3,378
Speed at 1,000 ft. piston speed	44.0 m.p.h.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	66.9
Weight on drivers ÷ tractive force	3.81
Total weight engine ÷ cylinder hp	109.2 lb.
Boiler proportions:	
Comb. heat surface ÷ cylinder hp	1.74
Tractive force ÷ comb. heat. surface	10.83
Tractive force × dia. drivers ÷ comb. heat. surface	749
Cylinder hp. ÷ grate area	40.1
Firebox heat. surface ÷ grate area	4.65
Firebox heat. surface, per cent of evap. heat surface	8.29
Superheat. surface, per cent of evap. heat. surface	26.42

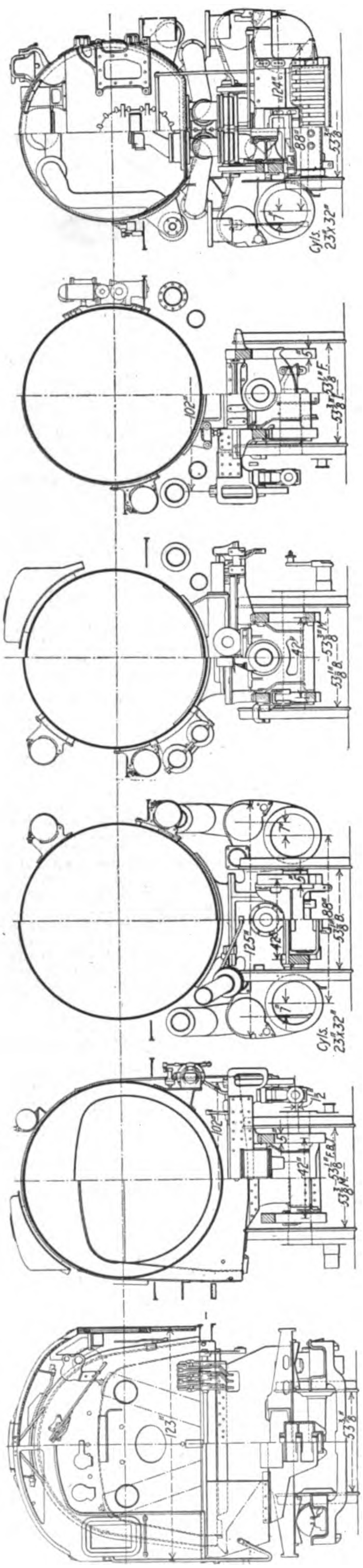
Eastbound, over the 61.5 per cent ruling grade, the practice has been to operate the milk trains with two Pacific type locomotives, one with a tractive force of 48,720 lb. and the other, with a tractive force of 41,530 lb., giving a total of 90,250 lb. The larger locomotive has cylinders 27 in. by 28 in., 73-in. driving wheels, and carries a boiler pressure of 205 lb. The total weight on the drivers of these locomotives is 204,560 lb. The lighter of the two locomotives has 25-in. by 28-in. cylinders, 77-in. drivers and carries a boiler pressure of 215 lb. In this case, the weight on drivers is 161,940 lb. The combined tonnage rating of the two locomotives is 1,300 tons, and the average train consists of 19 loads and one caboose.

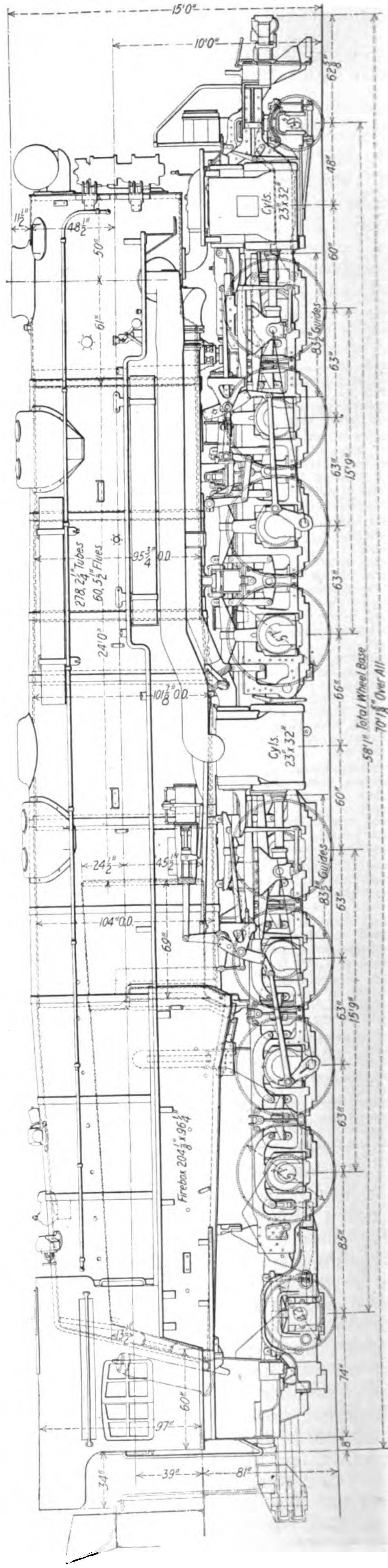
On the westbound trip, the train load averages 38 empty cars and two cabooses, and is handled by two Pacific type locomotives of the larger class briefly described above. This gives a total tractive force of 97,440 lb. Locomotive No. 5000 was given a trial trip with a milk train weighing a little over 1,300 tons, which it handled over the mountain without helper service, making schedule time. Since the trial trip, the locomotive has been regularly assigned to this service and, in some cases, has handled trains as heavy as 1,550 tons. On the westbound trip over the heavier grades of 63 to 65 ft. per mile, the locomotive has lost a little time on the schedule as compared with that made by the two Pacific type locomotives. The schedule over the division, however, has usually been maintained without difficulty, and time has been made up on several occasions. Speeds of over 60 miles an hour are frequently required on level track.

Summary of the Road Tests of Lehigh Valley Locomotive No. 5000

Date of test	Dec. 29	Dec. 30	Average
From	Tifft Farm	Manchester	....
To	Caledonia	Depew	....
Length of run, miles	59.4	77.4	68.4
Working distance, miles	56.4	62.4	59.4
Drifting distance, miles	3.0	15.0	9.0
Time, actual, start to stop	198	246	222
Time, delays, minutes	9	24	16
Time, running, minutes	189	222	207
Time, drifting, minutes	17	32	24
Number of stops	1	2	1.5
Number of cars in train, including caboose	94	64	79
Gross weight of train, excl. of locomotives	4,619 tons	3,929 tons	4,274 tons
100 ton-miles, based on distance run	2,744	3,041	2,892
Average speed while working, m.p.h.	19.68	19.70	19.69
Average speed while in motion, m.p.h.	18.87	20.92	19.89
Average temp. of feedwater in tank	40.2 ° F.	40.0 ° F.	40.1 ° F.
Average temp. of steam in branch pipe	615.5 ° F.	623.0 ° F.	619.3 ° F.
Average temp. of steam in exhaust	334.7 ° F.	310.7 ° F.	322.7 ° F.
Average pressure in boiler, lb.	185.6	194.1	189.9
Average pressure in saturated side of header, lb.	183.3	184.6	184.0
Average pressure in superheater side of header, lb.	175.6	180.6	178.1
Water from tank, lb.	131,840	138,550	135,195
Water lost at inj. overflow (est.) lb.	20	20	20
Water to auxiliaries, lb.	3,720	4,433	4,076
Water lost through pops, lb.	564	1,380	972
Water to cylinders, lb.	127,536	132,717	130,126
Water apparently evaporated per pound of coal as fired, lb.	7,288	7,658	7,473
Water app. evap. per hour, working time, lb.	45,984	43,746	44,865
Water to superheater per hour, per cent of total	96.75	95.80	96.28
Water per i.hp. per hour, incl. auxil., lb.	21.09	19.63	20.36
Water per i.hp. per hour, less auxil., lb.	20.40	18.80	19.60
Water per 100 ton-miles, lb.	48.04	45.55	46.80
Factor of evaporation, boiler only	1.226	1.227	1.226
Factor of evaporation, boiler and superheater	1.357	1.361	1.359
Factor of evaporation combined (B.t.u.'s in steam total divided by 970.4 × total water evaporated)	1.353	1.355	1.354
Coal as fired per hour, working time, lb.	6,310	5,713	6,012
Coal as fired per sq. ft. of grate per hour, lb.	74.85	67.77	71.31
Coal as fired per 100 ton-miles	6.59	5.95	6.27
Coal as fired per i.hp. hour, incl. auxil., lb.	2.89	2.56	2.72
Coal as fired per i.hp. hour, less auxil., lb.	2.81	2.47	2.64
Efficiency, combined, total B.t.u. in steam, divided by total B.t.u. in fuel	75.94	79.21	77.58
Total average i.hp. of locomotive	2,180	2,228	2,204
Average i.hp., right cylinder	722.4	722.1	722.3
Average i.hp., middle cylinder	764.2	803.9	784.0
Average i.hp., left cylinder	693.4	702.0	697.7
Maximum i.hp.	3,035	2,896	2,966
At a speed of, miles per hour	29	46	37.5
Average cut-off of locomotive, per cent of stroke	63.8	52.4	58.1
Average gage pressure at steam chest, lb.	174.0	176.0	175.0
Average initial pressure, lb.	171.5	172.0	171.8
Average mean effective pressure, lb.	120.2	99.2	109.7
Average least back pressure, lb.	13.7	11.9	12.8
Average back pressure at point of compression, lb.	15.6	14.5	15.0





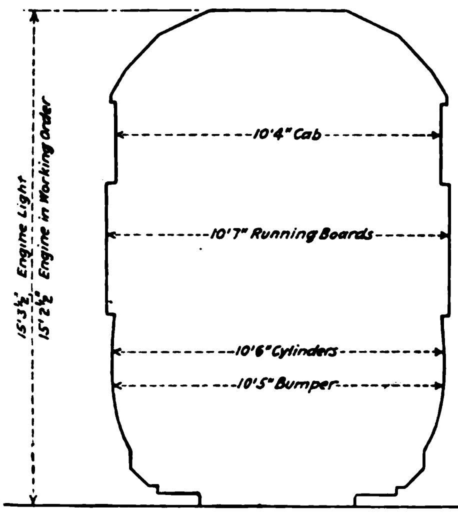


The Chesapeake & Ohio is Receiving 25 of These Powerful Simple Mallet Locomotives

Chesapeake & Ohio 2-8-8-2 Simple Mallet

Articulated Locomotive of 103,500 Lb. Tractive Force Designed to Meet Restricted Clearances

ONE of the most interesting of recent locomotive designs is that of the Chesapeake & Ohio 2-8-8-2 type single expansion Mallets, of which 25 are being delivered by the American Locomotive Company. The C. & O. has employed Mallet locomotives for a number of years, but these have been of the 2-6-6-2 type, 45 of which were placed in service during the period of the United States Railroad Administration. Practically all of the freight tonnage on the main line through the Allegheny mountains has been handled with these light Mallet type locomotives. When the new 2-8-8-2 type locomotives are placed in service on the



Restricted Clearance Lines to Which the C. & O. Mallet Design Was Required to Conform

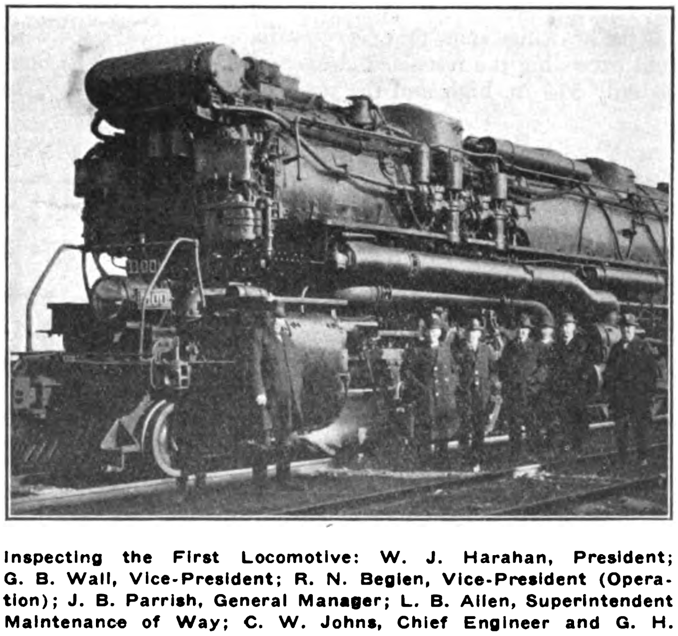
Mountain division, it is planned to extend the use of the lighter Mallets to the lower grade portions of the line where very heavy coal trains are successfully handled with relatively long runs. The C. & O. has a large equipment of high capacity steel coal cars, which makes it possible to assemble very heavy trains near the mining fields. These trains have to be hauled over the mountains and then through relatively level country to the seaboard. The new power will permit a material increase in the train load and make it possible to haul such trains through to the seaboard without breaking and reassembling.

The tunnels and restricted clearances on the C. & O. have prevented the use of the heavier type articulated locomotives of the usual design. The problem presented was therefore that of designing as powerful a locomotive as possible without exceeding the clearance limitations. As space was not available for compound cylinders, the very unusual practice of making all four cylinders high-pressure, single-expansion was adopted. While the almost universal practice in Mallet locomotives is to use double expansion, the Pennsylvania has had in operation for several years one large 2-8-8-0 simple Mallet with limited cut-off and a few small simple Mallets have been built at various times for export or industrial service. This is the first instance, however, in which any considerable number of large articulated locomotives of the single-expansion type have been built.

Another important consideration, which led to the unusual design of these locomotives, was the desire to operate them at higher running speeds than experience has shown to be practical for heavy compound articulated locomotives. By increasing both train loads and operating speeds, the maximum increase in traffic capacity could be obtained.

The new C. & O. engines, known as Class H-7, or Chesapeake type, and numbered from 1100 to 1124, are remarkable for their power, large boilers and compact, carefully worked out design. The maintenance of Mallet locomotives used in heavy service has always been considerable of a problem. This has been met on the C. & O. by organizing special repair gangs at all terminals and giving prompt attention to the features requiring attention without postponing work until the locomotive was removed from service for extensive repairs. Having had an extended experience with a considerable number of Mallet locomotives, it very properly followed that in making an entirely new design, careful attention was given to details so as to reduce attention and maintenance expenses to the lowest point possible.

These locomotives are practically two Consolidation engines with only one boiler. They measure 109 ft. 3⅜ in. from the front of the engine to the rear of the tender and have a total weight of 775,000 lb. in working order with the tender loaded. The distribution of the weight is as follows: 32,000 lb. on the front truck; 251,500 lb. on the forward set of drivers; 239,500 lb. on the second set of drivers, and 42,000 lb. on the trailing truck, making the total weight of the



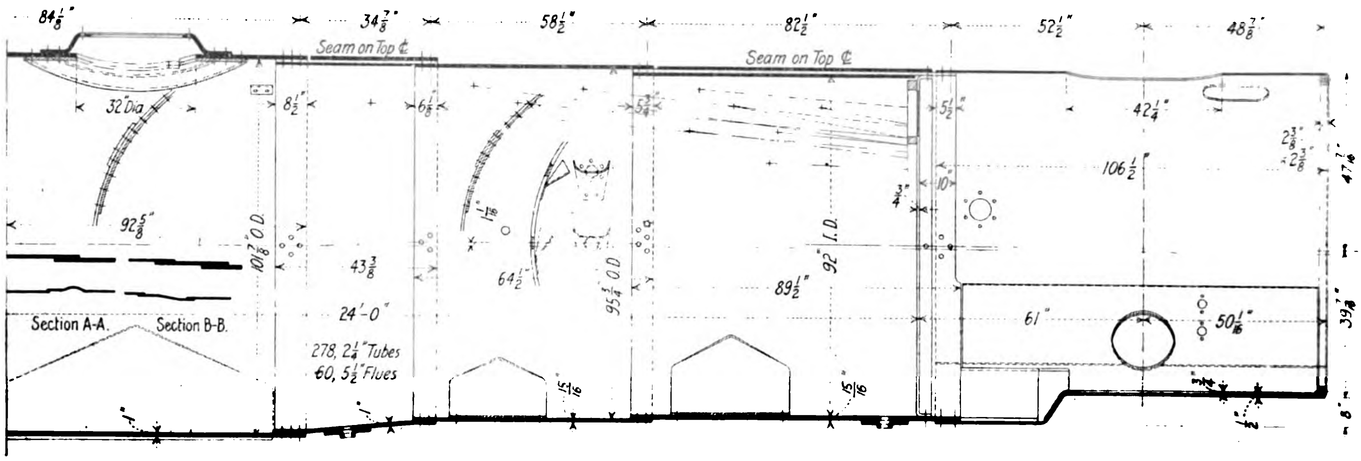
Inspecting the First Locomotive: W. J. Harahan, President; G. B. Wall, Vice-President; R. N. Beglen, Vice-President (Operation); J. B. Parrish, General Manager; L. B. Allen, Superintendent Maintenance of Way; C. W. Johns, Chief Engineer and G. H. Langton, General Master Mechanic

engine alone 565,000 lb. The engine alone is 70 ft. 1⅝ in. long. The driving wheel base of each unit is 15 ft. 9 in., the engine wheel base is 58 ft. 1 in., and the total wheel base of the engine and tender is 98 ft. ⅜ in. All four cylinders are 23 in. in diameter with a 32-in. stroke. The driving wheels are of 57 in. diameter and the rated tractive force of the locomotives is 103,500 lb. They are designed to operate on 20 deg. curves and on grades up to 1½ per cent.

In this connection it is of interest to note that the Class H-6, compound 2-6-6-2 type, Mallets hitherto used on the C. & O., weigh 441,000 lb., of which weight 368,500 lb. are on the drivers. The driving wheel base of each unit is

10 ft., the engine wheel base is 48 ft. 10 in. and the total wheel base of engine and tender is 86 ft. 11¾ in. The cylinders are 22 in. and 35 in. by 32 in., the driving wheels 56¼ in. diameter, the steam pressure 200 lb. and the rated tractive force 94,000 lb. simple, and 74,200 lb. compound.

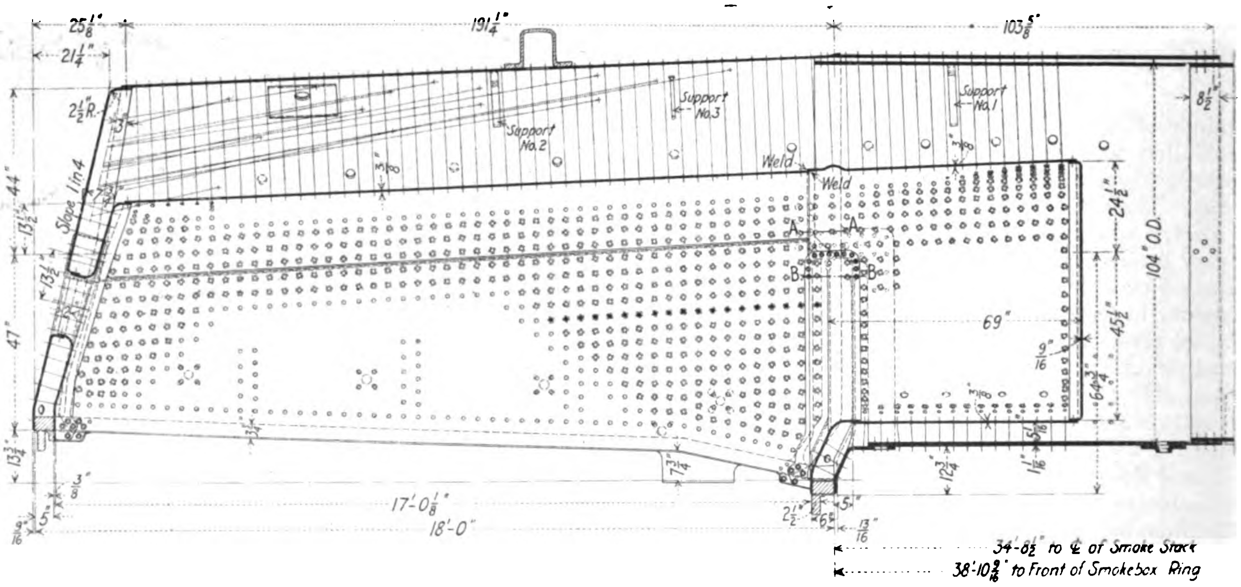
The boilers of the new Class H-7 Mallets are of an exceedingly interesting design and are the longest ones ever built at the Schenectady plant of the American Locomotive Company. The length from the front of the smokebox ring to the back end of the mud ring is 56 ft. 11⅛ in. The shell of the boiler, which is of the straight top type, consists of five courses, not including the smokebox or the firebox wrapper sheet. The inside diameter of the first course is 92 in. and the outside diameter of the course back of the dome is 104 in. diameter. The photograph of the locomotive as well as the drawings show that every available inch was used without exceeding the restricted clearances allowable. The dome is only 5½ in. high and the stack extension is but 11½ in. this be found advisable. There are 278 tubes, 2¼ in. diameter and 60 flues, 5½ in. diameter, the length being 24 ft. There is 6,443 sq. ft. of evaporative heating surface, 467 sq. ft. being in the firebox and 5,976 sq. ft. in the tubes and flues. The heating surface of the 60 units of the Type A superheater is 1,885 sq. ft. According to Cole's proportions, the rated cylinder horsepower is 3,902 hp. and that of the boiler 3,677 hp., or 94.2 per cent. This does not include any allowance for the effect of the two Elesco feedwater heaters, with which all these locomotives are equipped.



Front End of Boiler for C. & O. 2-8-8-2 Mallet Locomotive

The firing is done with a Duplex stoker, which is here called on to perform what is probably the most strenuous work ever demanded of it. The estimated coal consumption at the rate of 3¼ lb. per cylinder horsepower hour is 12,682 lb., or at the rate of 112.9 lb. per square foot of grate per hour.

The ash pan is of the self-cleaning hopper type and so designed that it can be taken down without removing the trailing wheels. It is built of ¼-in. steel and provision is made for washing down the sides while running. The air space through the ash pan dampers is 90 per cent of the gas area through the tubes and flues.



Firebox End of Boiler for C. & O. 2-8-8-2 Mallet Locomotive

The provision of ample boiler capacity is one of the conspicuous features of the design. Upon sufficient steaming capacity depends the ability to maintain the speed with trains which the locomotive was designed to haul. The wide firebox is 204⅛ in. long and 96¼ in. wide. It is fitted with a Gaines firewall and has a grate area of 112.9 sq. ft., 169 in. by 96¼ in., for burning soft coal. There is also a combustion chamber 69 in. long. Arch tubes are not used, although provision was made for their future application should

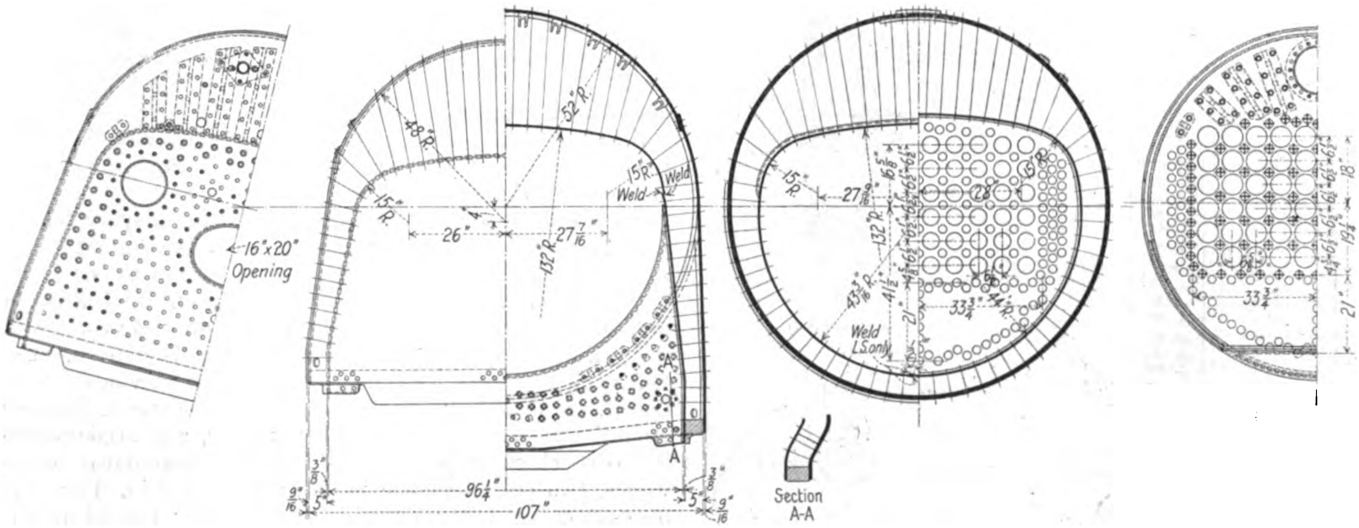
There are many interesting features about the boiler design, some of which are quickly apparent from an examination of the drawings. There is a large amount of exceptionally fine welding on the boilers. The welded joints include the long seam between the crown sheet and the firebox side sheets and

also between the combustion chamber and the firebox. At the joint the sheets are beveled 1/8 in. and lapped 1/2 in. with a weld on both sides, as shown in the detail drawing. At the junction of the combustion chamber and the firebox, a corrugation is provided, as shown in the drawings, this to better care for the expansion at this point.

The rated tractive force at 85 per cent with the four 23-in.

The leading truck is of the Commonwealth "Economy" constant resistance type. The trailing truck is of the Delta type. Engine truck, trailing truck and tender truck wheels are of forged steel, furnished by the Forged Steel Wheel Company.

The throttle in the dome is of the American Locomotive Company's design, top-lift type with a pilot valve. The



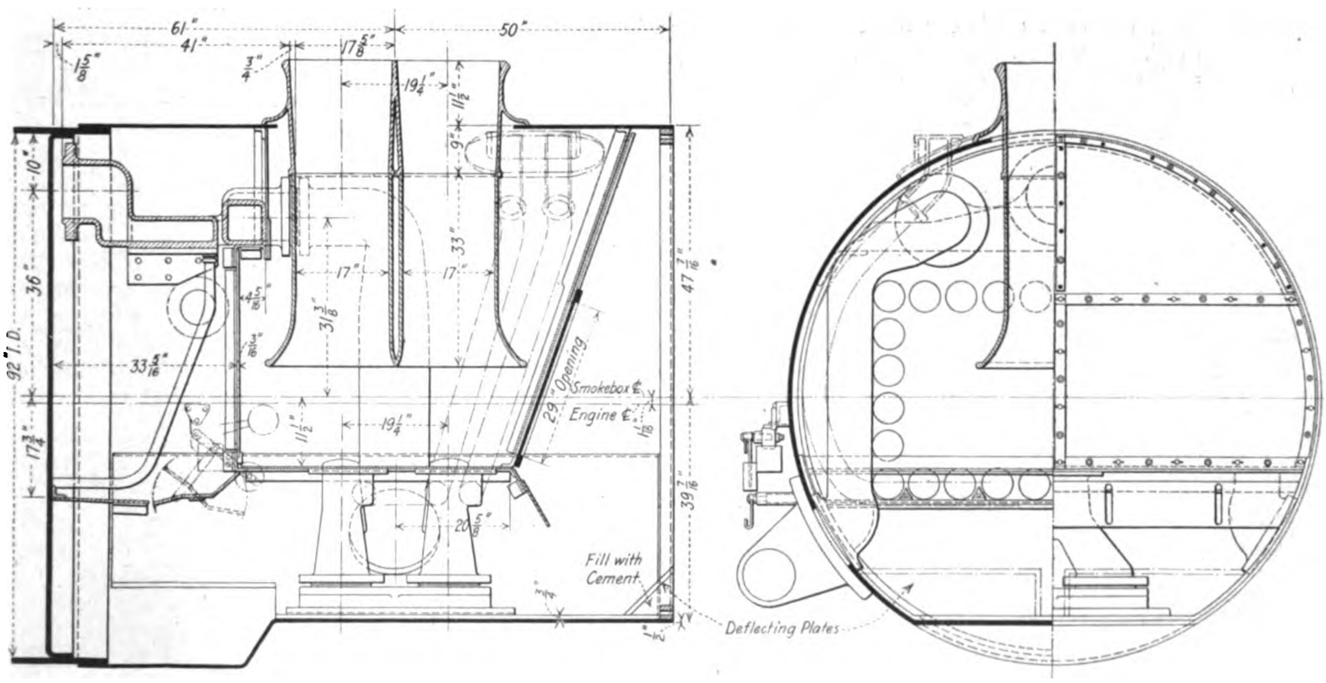
Back View and Cross-Sections of the C. & O. Mallet Boiler

by 32-in. cylinders, 57-in. driving wheels and 205 lb. steam pressure, is 103,500 lb. The steam is controlled by 14-in. piston valves operated by Walschaert valve gear. The reverse gear is the Alco, Type E. The cylinders are fitted with Mellin by-pass valves and vacuum relief valves.

Carbon-vanadium steel is used for the main and side rods, the crank pins, the piston rods, the wrist pins, the valve

dry pipe is 9 1/2 in. inside diameter, 1/4 in. thick. An unusual feature is that of the slipping throttle with a choke resembling a stove pipe damper in the rear unit exhaust pipes and the front unit steam pipe. These are operated by an air cylinder mechanism shown in one of the illustrations, independently controlled by three-way air valves located in the cab.

The smokebox front end is made in three sections. The



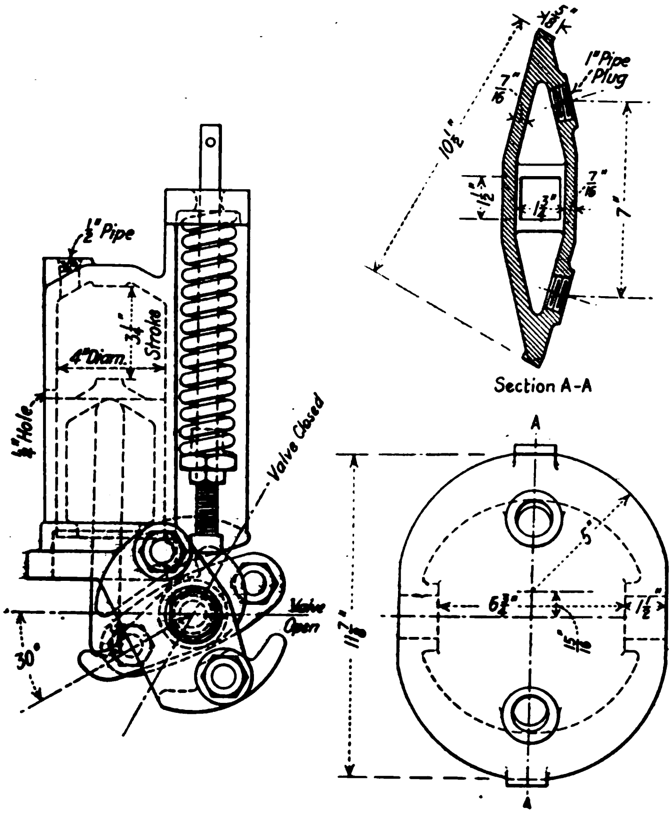
Smoke Box Construction Showing Design of Double Stack, One for Each Engine Unit

motion parts and also for the leading and trailing truck axles as well as the driving axles. The piston is of forged steel. The main driving axles, which have 11 1/2 in. by 13 in. journals and the other driving axles, which have 11 in. by 13 in. journals, are all hollow bored. The frames are of vanadium cast steel, furnished by the Union Steel Castings Company.

feedwater heater is mounted on the top section. The lower sections are divided vertically. An 8 1/2-in. cross-compound air compressor is mounted on each of these sections, which are arranged to swing out with the air compressor on Okadee hinges. A center plate is also provided which permits of access to the front end without disturbing the air compressors or the feedwater heater.

The headlights, Pyle-National Type K-2, operated by a turbo-generator, are placed down near the bumper beams.

These locomotives will be operated through a number of tunnels, some of which are quite long. A noteworthy feature



Control Mechanism for Slipping Throttle

is the provision that has been made for the comfort of the enginemen while passing through these tunnels. As a result of extended tests made by the mechanical department of the C. & O., assisted by experts from the Bureau of Mines, Department of the Interior, two steel fan blowers, Buffalo Forge Company's size No. 2, were installed under the cab deck, one on each side. They are driven independently by Pyle-National, Type K, headlight turbines. The inlet air pipes lead back to the space between the engine and tender with the discharge pipes leading up into the cab. This arrangement provides a stream of comparatively pure air and at the same time reduces the temperature in the cab. As a further precaution, three gas masks are provided. These receive their air supply from the main reservoir. Moreover the back boiler head is lagged down to the deck and all cab steam pipes covered with Unarco Asbestos Insulate.

The tender is of the Vanderbilt type and holds 12,000 gal. of water and 15 tons of coal. It is mounted on a single-piece, cast steel frame. The trucks are of the four-wheel type with Andrew's cast steel side frames and cast steel bolsters furnished by the American Steel Foundries. The tender coupler is a Type D with 6-in. by 8-in. shank and 5¼-in. butt. The draft gear is a Miner A-18-S-2, with Farlow two-key attachments. A Franklin unit safety drawbar connects the locomotive and tender.

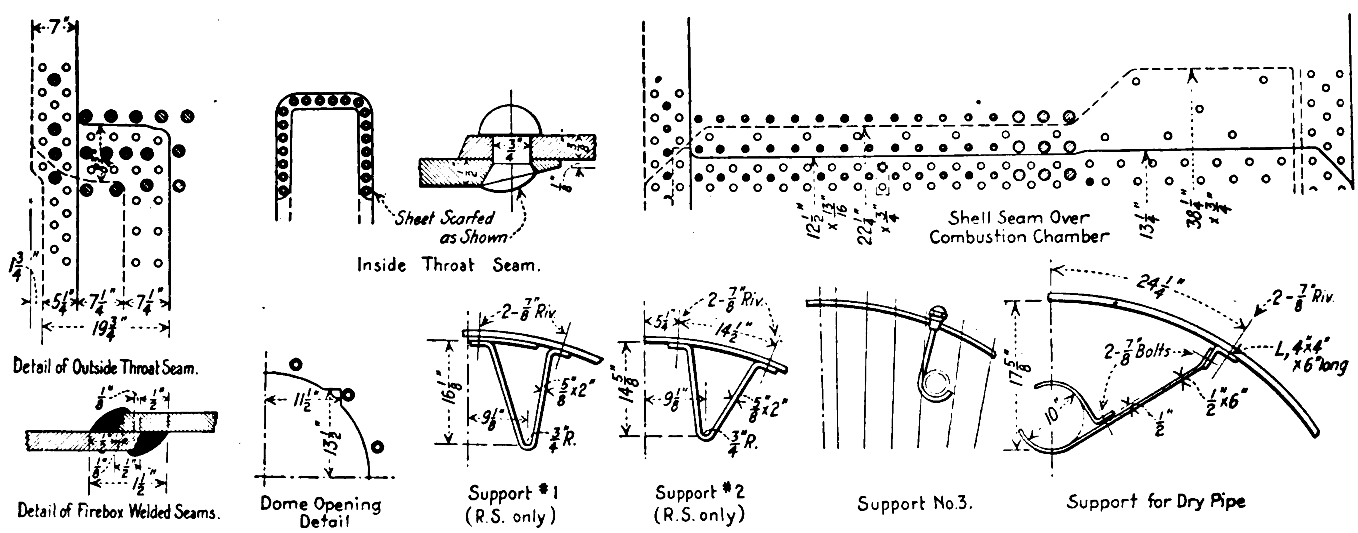
Some difficulty was experienced in finding a space for the main reservoirs of the Westinghouse air brake system. This was finally taken care of by using three reservoirs, one 14-in. by 144-in. on the right-hand side, one 14-in. by 108-in. on the left-hand side and one 14-in. by 120-in. near the top of the boiler. The total reservoir capacity is 70,696 cu. in.

Among the specialties the following, not previously mentioned, are included: Hancock non-lifting Type K injectors having a capacity of 9,000 gal. per hour, and accompanied by 3-in. check valves; three 3½-in. Consolidated safety valves, two open and one muffled; Okadee 2-in. Type FH blow-off cocks; Okadee WG 13 water gages; Franklin grate shaker and No. 8 firedoor; Nathan eight-feed lubricator; Graham-White sanders; Detroit flange oilers; United States Metallic packings for piston rods and valve stems; Hunt-Spiller gun metal bushings for cylinders and valve chests; and Barco flexible joints in air lines between engine and tender and screw type flexible joints in main reservoir pipes.

The general dimensions and proportions of these interesting locomotives are given in an accompanying table.

Table of Dimensions, Weights and Proportions

Railroad	C. & O.
Builder	American Loco. Co.
Type of locomotive	2-8-8-2 Simple
Service	Freight
4 cylinders, diameter and stroke	23 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	6 in.
Outside lap	1 in.



Some Details of the Boiler for the C. & O. Mallet Locomotive

Exhaust clearance	0
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	491,000 lb.
On front truck	32,000 lb.
On trailing truck	42,000 lb.
Total engine	565,000 lb.
Tender	210,000 lb.

Wheel bases:	
Driving, each	15 ft. 9 in.
Rigid, each	15 ft. 9 in.
Total engine	58 ft. 1 in.
Total engine and tender	98 ft. ⅛ in.
Wheels, diameter outside tires:	
Driving	57 in.
Front truck	30 in.
Trailing truck	42 in.
Journals, diameter and length:	
Driving, main	11½ in. by 13 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	8 in. by 14 in.
Boiler:	
Type	Straight ton
Steam pressure	205 lb.
Fuel	Bituminous coal
Diameter, first ring, inside	92 in.
Firebox, length and width	204⅛ in. by 96¼ in.
Height mud ring to crown sheet, back	60½ in.
Height mud ring to crown sheet, front	89¼ in.
Combustion chamber length	69 in.
Tubes, number and diameter	278–2¼ in.
Flues, number and diameter	60–5½ in.
Length over tube sheets	24 ft.
Grate area 169 in. by 96¼ in.	112.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	467 sq. ft.
Tubes	3,912 sq. ft.
Flues	2,064 sq. ft.
Total evaporative	6,443 sq. ft.
Superheating	1,885 sq. ft.
Comb. evaporative and superheating	8,328 sq. ft.
Tender:	
Style	Cylindrical
Water capacity	12,000 gal.
Coal capacity	15 tons
Trucks	Four-wheel
General data estimated:	
Rated tractive force, 85 per cent	103,500 lb.
Cylinder horsepower (Cole)	3,902 hp.
Boiler horsepower (Cole) (est.) *	3,677 hp.
Speed at 1,000 ft. piston speed	31.8 m.p.h.
Steam required per hour	81,162 lb.
Boiler evaporative capacity per hour *	76,472 lb.
Coal required per hour, total	12,682 lb.
Coal rate per sq. ft. grate per hour	112.9 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	86.9
Weight on drivers ÷ tractive force	4.91
Total weight engine ÷ cylinder hp	147.1
Total weight engine ÷ boiler hp	156.1
Total weight engine ÷ comb. heat. surface	67.9
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent *	94.2
Comb. heat surface ÷ cylinder hp	2.13
Tractive force ÷ comb. heat. surface	12.42
Tractive force × dia. drivers ÷ comb. heat. surface	708
Cylinder hp. ÷ grate area	34.5
Firebox heat. surface ÷ grate area	4.40
Firebox heat. surface, per cent of evap. heat. surface	7.72
Superheat. surface, per cent of evap. heat. surface	29.25

* No allowance for feedwater heaters included.

Paris-Orleans Condensing Locomotive

Means Adopted on Suburban Tank Locomotive for Condensing Exhaust Steam While Passing Through a Long Tunnel

By H. Leflot
Inspector of Equipment, Paris-Orleans Railway

The Paris-Luxembourg line to Sceaux and Limours runs well into the City of Paris and passes through a tunnel, a little over a mile long, situated between the stations of Paris-Luxembourg and Paris-Denfert. When the line was built it was apparent that certain measures must be taken to avoid inconvenience to the passengers from the escaping smoke and steam of the locomotive during the passage through the tunnel.

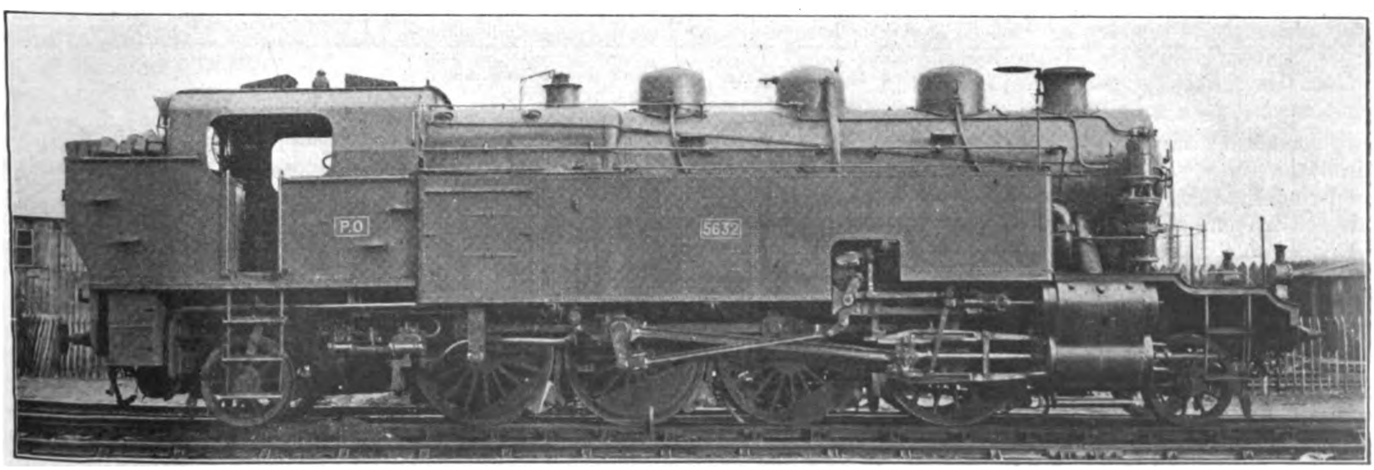
Black smoke could be done away with by special care in the control of the fire, but the question of the exhaust steam remained. To overcome this trouble, the Paris-Orleans railroad equipped a locomotive with an arrangement for condensing in the water tank as much of the exhaust steam as possible.

On the first locomotive equipped with condensing apparatus the boilers were fed by injectors. Upon reaching the end of the tunnel at Denfert, it was found necessary to partly empty the tanks and replace the hot water by cold water taken at the water crane, in order to obtain a sufficiently low temperature to secure reliable action of the injectors.

Furthermore, to insure a supply of water to the boiler during the time the condensing apparatus was in operation, a supplementary cold water tank, having a capacity of 106 gallons, was employed. This tank was so arranged that it could be placed in communication with the ordinary tanks or held in reserve until needed.

This method of operation wasted a considerable amount of water and fuel and caused an undesirable loss of time between stations only a short distance apart, where quick service was important.

The original locomotives having become incapable of making the running time with the increasing traffic that had to be handled, it was decided to replace them by more power-



Paris-Orleans Suburban Tank Locomotive Equipped with Exhaust Condensing Apparatus

ful tank locomotives of the 2-8-2 type fitted with superheaters. At this time, in order to do away with the inconveniences mentioned, we developed a new condensing apparatus and applied two Worthington pumps for feeding the boiler. This permitted using the water in the tank at all times no matter what the temperature might be.

Description of the Condensing Apparatus

As will be noted from the drawings, this apparatus is a sort of surface condenser. It consists of copper exhaust pipes *C*, brass pipes, *E*, for condensing the exhaust or discharging above the water in the tank any steam that has not been condensed, also copper pipes, *G*, which permits the final escape to the atmosphere of the non-condensed steam if any still remains.

The waste pipes are two in number; the main waste pipe, *K*, terminates underneath the coal box and has at the end a double elbow, which forms a trap to prevent the escape of the non-condensed steam in the pipe *E*. The other pipe, K^1, discharges the water of condensation between the first and second pair of driving wheels.

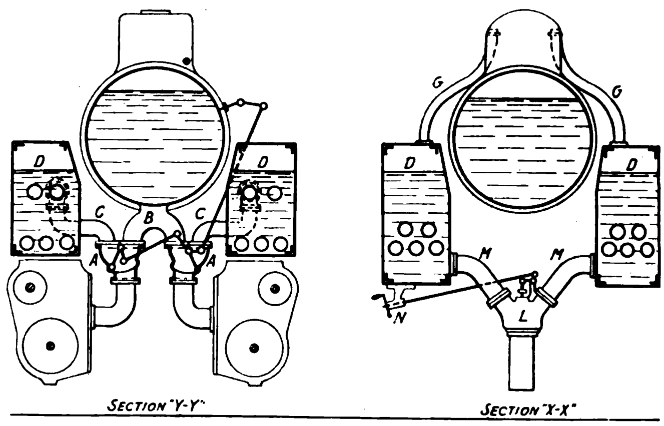
To permit the utilization of the apparatus at will, a control valve, *A*, is placed in the exhaust pipe of each cylinder. Both of these valves are operated by the handle, *J*, located conveniently for the engineman. This permits the directing of the exhaust steam into the water tanks or to the atmosphere by way of the stack.

The two water tanks, *D*, are connected by the cross-over pipe, *M*. They can be emptied by a valve, *L*, operated by the handle, *N*, shown in the cross section. There is also a pipe, *S*, connecting the front and the back portion of the tank to secure a circulation of water and to divide the heat evenly throughout the tank.

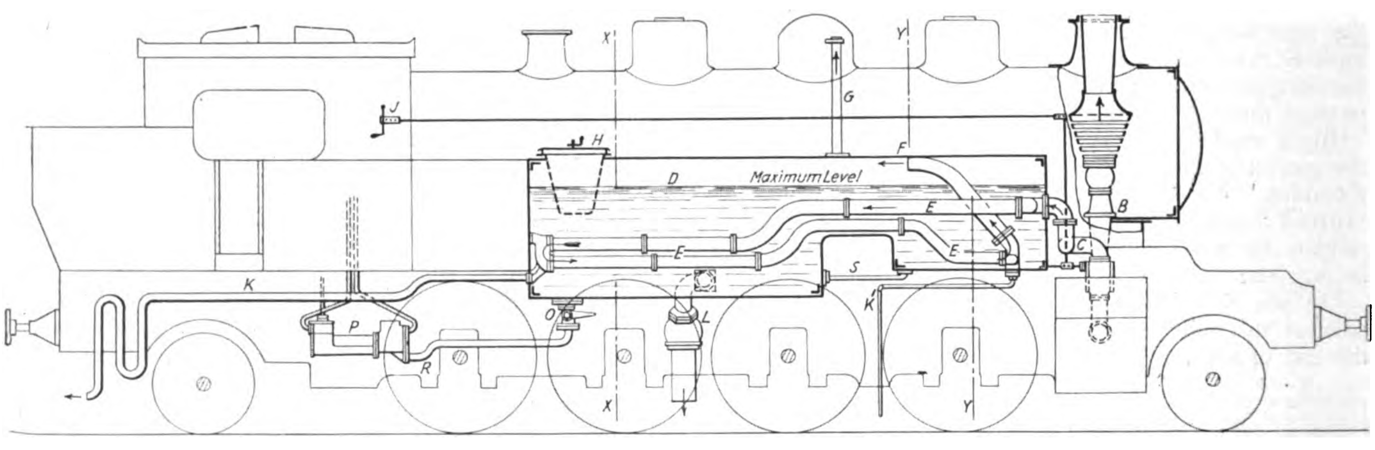
Operation of the Device

By suitably adjusting the valves, *A*, by the handle, *J*, communication is established between the exhaust pipe and the condensing apparatus. The exhaust steam is then directed into the pipes, *E*, and there partly condensed, while the remainder passes out by the top extension, *F*, to be condensed by contact with the surface of the water in the tanks. Any surplus of steam not condensed escapes in the atmosphere by the vent pipe, *G*, and the water of condensation passed away by the waste pipes, *K* and K^1, as shown on the elevation drawing of the locomotive.

The cover, *H*, of the water tank is kept tightly closed to avoid the escape of the steam and projection of water on to the tracks. The volume of water contained in the tanks at the maximum level, which is indicated by a gage cock placed on a partition on the side of the tank, is 212 cu. ft., or 1,585 gallons. The maximum level is at 13½ in. from the top of the reservoir. Should this level be exceeded and a surge of water caused by the motion of the locomotive reach the top of the condensation pipe, the surplus would pass off by the waste pipes, *K* and K^1, following a course the reverse of the one taken by the condensed steam outlined in the preceding paragraph.



Cross Sections



Elevation Showing Water Tank and Condensing Apparatus

By means of cocks, suitably located, the engineman may divert the exhaust steam from the feedwater pumps either to the atmosphere or to pipes leading to the water tanks. The exhaust steam from the air compressor is piped to one of the locomotive exhaust passages, *A*, and follows the same course as the exhaust from the main engine cylinders.

Summary

It is apparent from what has been stated that the exhaust steam condensing apparatus of the new tank locomotive on the line between Paris and Limours has succeeded in solving the particular problem of the suppression and the escape of the exhaust steam to the atmosphere during the passage through the tunnel.

Economy of fuel was not the object aimed at. There is no doubt, however, that the condensing apparatus results in some saving due to the heating of the feedwater, but this saving is small inasmuch as the condensing apparatus functions only between the two stations of Denfert and Luxembourg, less than a mile apart. When it functions and all the exhaust steam is sent into the water tanks, the draft is almost completely extinguished and the use of the blower becomes necessary. This reduces the economy resulting from the recovery of the heat contained in the exhaust steam from the cylinders.

Encouraging Apprentices by Competitive Methods*

Boys Should Be Checked Up Periodically to Make Sure They Have Mastered the Various Classes of Work

By Earl D. Austin

Machinist Apprentice, Chicago, Milwaukee & St. Paul, Galewood, Ill.

In my opinion the four-year training plan is not the correct method to produce good mechanics. Most any boy can pass the first examination and enter his apprenticeship. Then he serves his time and becomes a machinist whether he is a dependable one or not. This system makes the goal of the boys the time they have left to serve—not the kind of mechanics they are going to make.

What would the schools of our country be if the boys and girls were graduated after four years, regardless of whether they had acquired the necessary knowledge or not. I do not think they would be of much account; schools are not run on that plan. A boy passes an examination to enter high school and then after each course he has to pass an examination to prove that he thoroughly understands the subject and he is graded accordingly. Is not the apprentice a scholar just as is the high school boy?

Earl D. Austin

There is nothing that makes a boy study and work harder than trying to get ahead of the other fellow and be ahead in his monthly markings. The apprentice boy should be rated on a percentage basis every month and it should be posted on the bulletin board. When a boy heads the list it makes him feel proud and determined to stay at the top of the list, while those at the bottom are ashamed and will try hard to crawl to the top. There is nothing that makes a boy more determined to win than a contest of this sort. I could hardly wait until the names and percentages were posted to see how I ranked among my fellow apprentices. These percentages should not be marked by the foreman alone, but by the apprentice instructor, if one, and also the mechanic the boy is working under.

The boy should also pass an examination and show the foreman that he understands the job thoroughly before he is allowed to go to another class of work. Suppose, for instance, the boy is running a lathe; when he has been on it four months, or the specified time, he should show the foreman that he can operate the lathe correctly before he is allowed to work on another machine. He should also pass a written examination on the operation of the lathe and such questions as the number of threads to the inch, the taper of standards parts, etc. If the boy passes the examination, he should be put on another class of work; if not, he should stay on lathe work until he can pass the examination satisfactorily. If he is a good mechanic he will pass from one class of work to another regularly. If not he should give up and try some other trade. As it is now, the boys all go on regardless of their qualifications. These examinations will also encourage the boy to study at home to finish his apprenticeship sooner.

The average apprentice of today figures that there is no use in studying, as he will be a mechanic in four years, whether he studies or not. It is not right for the management to turn out a poor mechanic from the shops, as he will never succeed in life by working at a trade not properly mastered. It is far better to discharge the boy and let him pick a trade he is better suited for.

If the system above suggested was followed there would not be as many poor mechanics in the country who cannot hold their jobs; these men go from job to job and are always an expense to the railways which hire them. There would probably be a few less mechanics in this country, but you would know when you hired one that you were hiring a first-class mechanic who would make money for the company; you would not have to find a job to which he was suited, but could give him any job.

Competition is what has made our country so progressive. Would we have the easy-riding steel coach and the powerful locomotive that takes us across the country at the rate of 60 miles an hour if it was not for competition? No! We would be riding in the hard-creaking wooden coach drawn by the slow-moving locomotive. If competition will make good railways it will make good mechanics; so the more competition a management can promote among their apprentices, the better mechanics they will produce.

If this system of training apprentices was taken along with the schooling and social system on the Santa Fe, this country would be better equipped to take care of its motive power.

A Small Boy said that a gun was dangerous without lock, stock or barrel, because his daddy licked him with the ramrod. Careless men find ways to hurt themselves anywhere, while careful men can do hazardous work all their lives and never get a scratch. —The Night Watchman.

*Awarded honorable mention in the competition for regular apprentices which closed Sept. 1, 1923.

Elimination of Errors in Stephenson Valve Motion

A Detail Method Is Given for Determining the Offset of the Link Saddle Pin and the Principal Factors in Design Are Discussed

By Roy C. Beaver
Assistant Mechanical Engineer, Bessemer & Lake Erie, Greenville, Pa.

WHAT is the correct offset of the link saddle pin on a Stephenson valve gear? Can you give a detailed method of determining this offset? The answer to this question, asked by a reader, is contained in Mr. Beaver's article. The offset referred to in the discussion, indicated by the question mark shown on the drawing of the link, is the means used to compensate for errors existing in the valve gear design. Although the Stephenson gear is rarely installed on new equipment, it is a well-known fact that a large number of shop men have to deal with it on the older locomotives. If an old Stephenson gear is causing you trouble perhaps you will find the reason here.

THERE are several sources of error inherent in the design of the Stephenson valve gear as applied to locomotives, which, unless compensated for, cause the valve events to occur at different times on the forward and backward strokes, thus making the valves out of square. The three principal sources of error, and the only three which it is customary to overcome in the design, are the angularity of the main rod, the angularity of the eccentric blades and the fact that the eccentric blade pins are not placed on the link arc, but, on account of the construction of the link are set some distance inside.

The effect of the first two of these errors is to cause the link block, and hence the valve, to lag behind the proper positions, with respect to the piston position, during the backward stroke of the piston and to the link block, and hence the valve, to run ahead during the forward stroke of the piston.

The effect of the third of these errors is just the opposite. The valve is caused to lag behind its proper position during the forward stroke and to run ahead during the backward stroke of the piston.

The effects of the first two errors are thus added together and counteracted by the effect of the third error, but the effect of the third error does not entirely compensate for the combined effect of the first two. Therefore, an additional condition must be introduced which will complete the compensation. This additional condition is the back-setting of the link saddle pin from its theoretical position on the link arc to a point inside of the link arc.

Angularity of the Main Rod

The manner in which these errors are introduced and the effects produced upon the link are shown in the accompanying diagrams. Fig. 1 shows the effect produced by the angularity of the main rod. Ordinarily when we think of main rod angularity, we think of the erratic motion it produces upon the piston. However, we must consider the piston to have a true motion and the error to be developed at the crank pin end. The point *A* shows the position of the crosshead wrist pin when the piston is at the middle of its stroke. The length of the main rod is *AO*. Therefore, the arc *BOB'*, described through the point *O* with the radius *AO*, shows that at mid-stroke the crank pin is at the point *B* for the bottom quarter, instead of at *C*, and for the top quarter is at the point *B'* instead of at *C'*. The distance *CB* then represents the amount the crank pin lags behind its proper position at the bottom quarter and the distance *C'B'* represents the amount the crank pin runs ahead at the top quarter. This error is zero at the front and back dead centers, and is greatest at the quarter positions; that is, it increases from zero to maximum through 90 deg. and back to zero in the next 90 deg. Thus, as noted above, the crank pin, and hence the link, lags behind the proper position during the backward stroke of the piston and runs ahead during the forward stroke.

The result of this erratic motion is shown by the solid lines in Fig. 1. These lines show the position of the eccentrics, eccentric blades and link when the crank pin is at *B*. The dotted lines show the proper positions which these parts would have if the crank pin were at *C*. Neglecting for the moment the effect of the other two errors mentioned, it is seen that the center of the link is at *D* instead of *D'* and the link block is at *E* instead of *E'*, the distances *DD'* and *EE'* representing the amounts the link center and link block lag behind their proper positions during a backward stroke of the piston. The link is then traveling in the direction of the arrow. This lagging of the link block, transmitted to the valve, causes the valve events to be retarded at the front port during the backward stroke. By completing the diagram for the top quarter position, it may be shown that the valve events are hastened at the back port for the forward stroke.

Fig. 2 shows the effect produced on the link by the angularity of the eccentric blades. Neglecting for the moment the effect of the angularity of the main rod and the effect of the back-set of the eccentric blade pins, when the crank pin is at front center, the center of the link is at *F*. When the crank pin has moved through 90 deg. to the bottom quarter, the center of the link has moved the distance *y* to the position *G*. When the crank pin has moved through the second 90 deg. to back center, the center of the link has moved the distance *x* to the point *H*. It will be seen that the distance *x* is greater than the distance *y*, so that the center of the link has not moved equal distances for equal movements of the crank pin. Now when the crank pin passes through the third 90 deg. to top center, the center of the link moves back through the distance *x* to the point *G'*, and when the crank pin completes the full revolution the center of the link will have moved back through the distance *y* to its starting point at *F*. The error thus increases from zero to maximum when the crank pin travels from 0 deg. to 180 deg., and the error decreases again to zero through the next half revolution.

The link must move faster in order to travel the distance *x* in the same time it travels the shorter distance *y*. This speeding up of the link at one end of the stroke causes the valve events to be out of time at the front and back ports. Assuming the engine to be running forward, it may further

be seen that the slow travel of the link occurs in the first and fourth quarters, or while the crank pin is traveling from the top quarter to the bottom quarter positions, and the represent the actual positions of the link block at the forward and back link positions, respectively, while J' and K' represent the corresponding proper positions of the link.

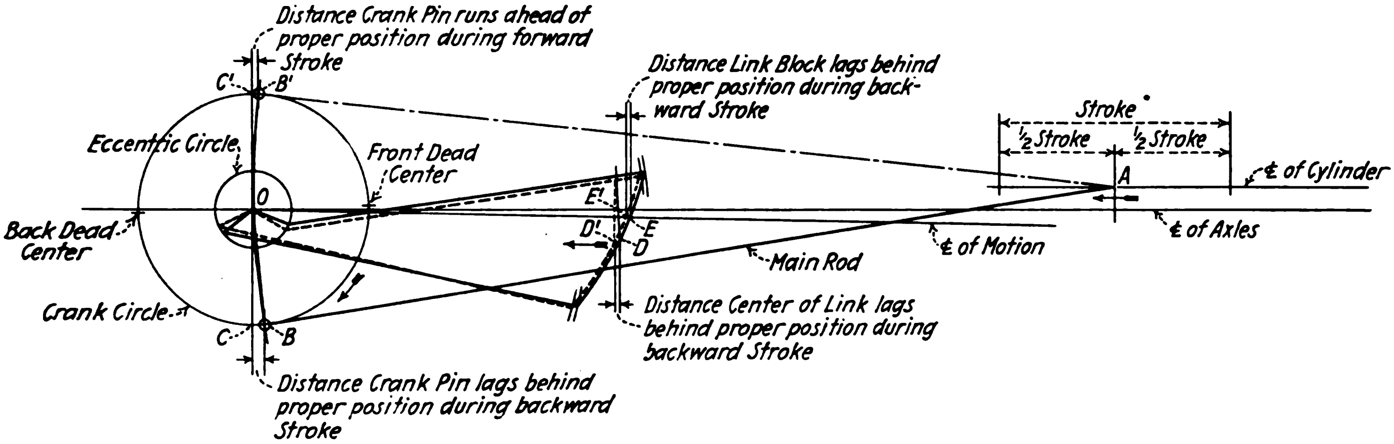
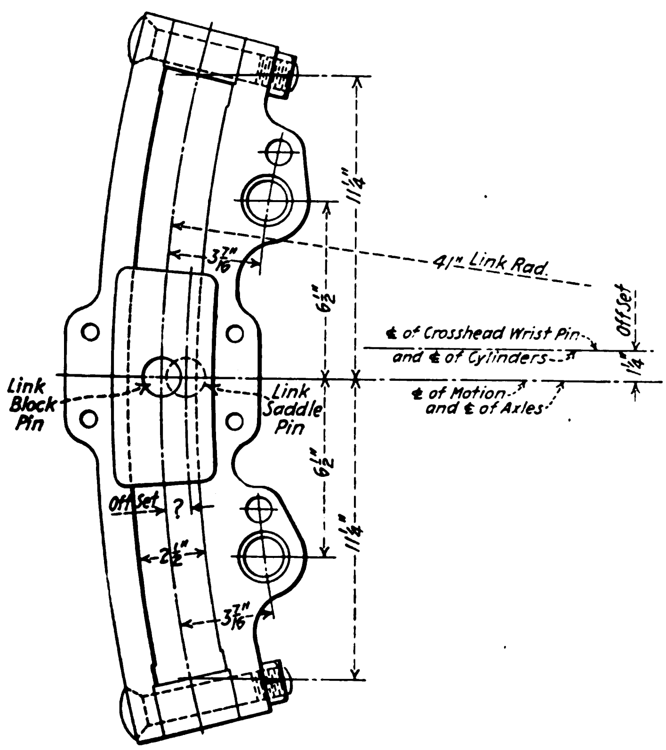


Fig. 1—Errors Caused by the Angularity of the Main Rod

piston is at the forward end of the stroke. At this time the blades are in open position and the angularity is the least. The fast travel of the link occurs in the second and third quarters, or while the crank pin is traveling from the bottom quarter to the top quarter positions, and the piston is at the back end of the stroke. It is in this phase that the blades are in crossed position, and the angularity is the greatest. This action causes the valve events to be slow at the front port and ahead of time at the back port. The



Link on a Stephenson Valve Gear Showing the Offset of the Saddle Pin

effect is the same and must be added to the effect produced by the angularity of the main rod.

Proper Positions of the Link Block

Fig. 3 shows the relation of the proper and the actual positions of the link if the effect of angularity has not been overcome. The effect of the error produced by the offset of the eccentric blade pins has been disregarded. J and K

The point J is behind and the point K is ahead of its proper position. Now if the link could be raised vertically, there would be a point N on the link which would fall on J', and

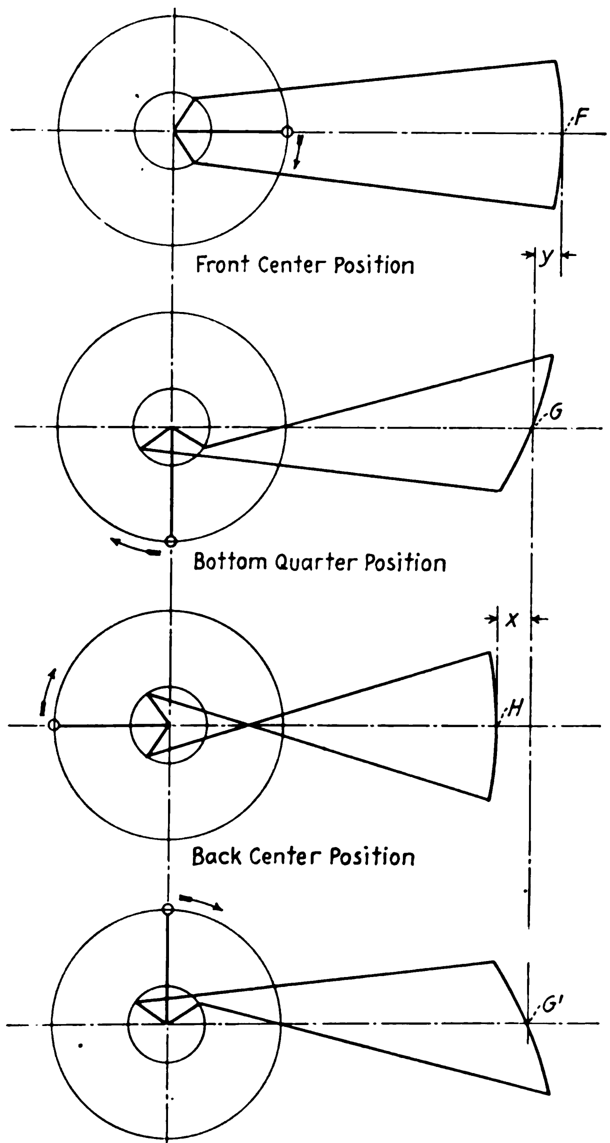


Fig. 2—Errors Caused by the Angularity of the Eccentric Blades

if the link could be lowered vertically, there would be a point M on the link which would fall on K'. Therefore, the link should be raised at the forward position and lowered at the back position. This is accomplished by offsetting the link saddle pin, which produces the effect shown in Fig. 4. The offset PQ acts as a lever about the point Q that raises and lowers the link through the distance z.

This brings the saddle pin outside of the link arc, but it is usual in locomotive practice to find it inside. The reason

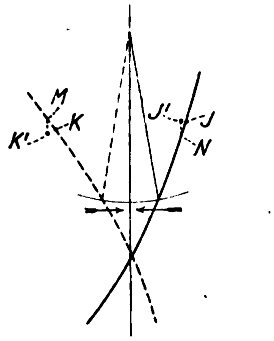


Fig. 3—Relation of Proper and Actual Positions of the Link Block

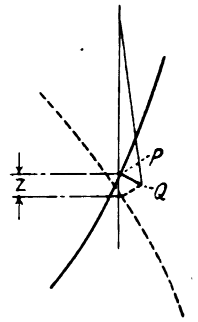


Fig. 4—Effect of the Method Used for Compensating for Angularity

for this is that the effect of the third error, which will now be discussed, is greater than the other two, and opposite in direction, so that in compensating for it, the saddle pin is brought back to a point within the link arc.

The effect of the third error, or the offset of the eccentric blade pins is shown in Fig. 5. The figure is drawn to show this error alone and neglects the effect of the other two. The solid lines show the actual positions of the eccentric blades and link and the dotted lines show their proper positions. The construction introduces a toggle joint which causes the link to be drawn toward the axle. The distances $US' + S'S''$ and $VT' + T'T''$ are equal to the distances US and VT respectively, and not being in straight lines, are greater respectively than the distances US'' and VT''. Hence the link is drawn toward the axle the distance RR'. The link is, therefore, always farther toward the back of the locomotive than it should be, so that when the link is traveling forward, it lags behind and when it is traveling backward it runs ahead of its proper position. The forward travel of the link occurs when the piston is in the back end of the stroke, and the backward travel occurs when the piston is in the forward end of the stroke, when the engine is running forward. Thus the valve events are slow at the back port and ahead of time at the front port.

The effect of this error is just the opposite of those due to the angularity of the main rod and the eccentric blades. This effect must be compensated for by just the opposite process; that is, by moving the saddle pin back to some point within the link arc.

The amount of offset of the saddle pin required to compensate for each error could be determined separately on the drawing board, and the algebraic sum of these amounts could be taken as the net amount to move the pin. However, the required movement of the pin to compensate for all three errors may be determined at once by the method shown in Fig. 6. Make your decision as to the point of cut-off at which you desire the locomotive to be worked. Locate the positions of the crank pin as shown at X and Y, which have in Fig. 6 been located for a cut-off of 25 per cent. Then locate the positions of the eccentrics for each of these positions, as at p, p' and q, q'. If the angle $p\ o\ p'$ is not known from given dimensions of the locomotive, it may be determined by taking the horizontal distance w equal to the amount the lower end of the rocker arm moves. At the same time the top end of the rocker arm moves a distance equal to the lap plus the lead and then the angle $p\ o\ p'$ equals the angle ZOW. Next locate the link block ahead of and back of its central position a distance equal to the amount the lower end of the rocker moves when the upper end moves a distance equal to the lap, as shown at L and L'. Then from the given dimensions of the eccentric blades and link, locate these parts so that the link will pass through the points L and L'. There is only one position which the link can occupy to fulfill this condition for each position of the crank pin. A paper template of the link will greatly assist in locating the link properly.

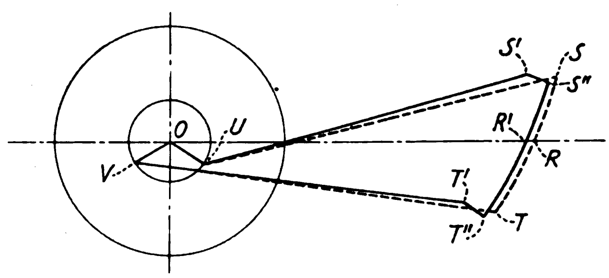


Fig. 5—Effect of the Back-Set of the Eccentric Blade Pins

Through the middle points of the link in the two positions, draw the lines ab and cd perpendicular to the link arc. Evidently the saddle pin must be located somewhere on each of these lines and, at the same time, move in an arc about the center O', so that it will be located in a line gh, parallel to the center line of motion at the two link positions shown. We may then find by trial a location for the line gh parallel to the center line of motion, such that it will intercept the equal distances ef and mn from the link arc on the lines ab and cd respectively. These equal distances ef and mn represent the back set of the link saddle pin.

Any location of the saddle pin will give proper valve events at only one point of cut-off, due to other errors which exist in the valve gear, and for this reason the back-set of the pin must be made such that the engine will be square at the point of cut-off where the locomotive is most likely to be worked. The other errors, however, are small and unimportant. Experience has shown that when the effects of the errors just described are eliminated, the locomotive is, for all practical purposes, a very smooth running machine.

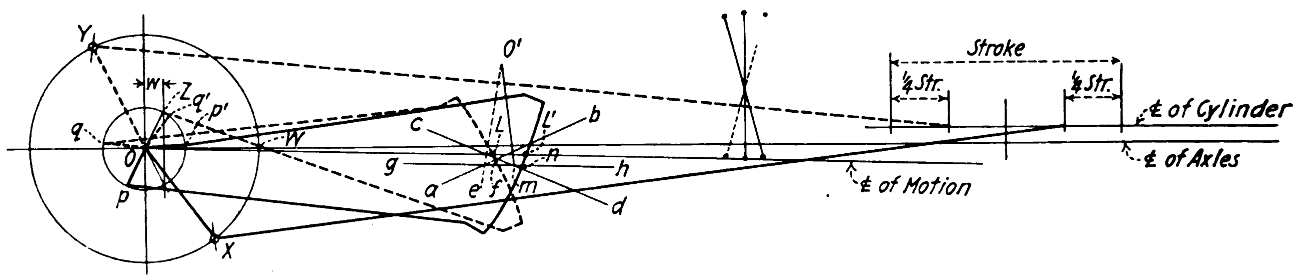
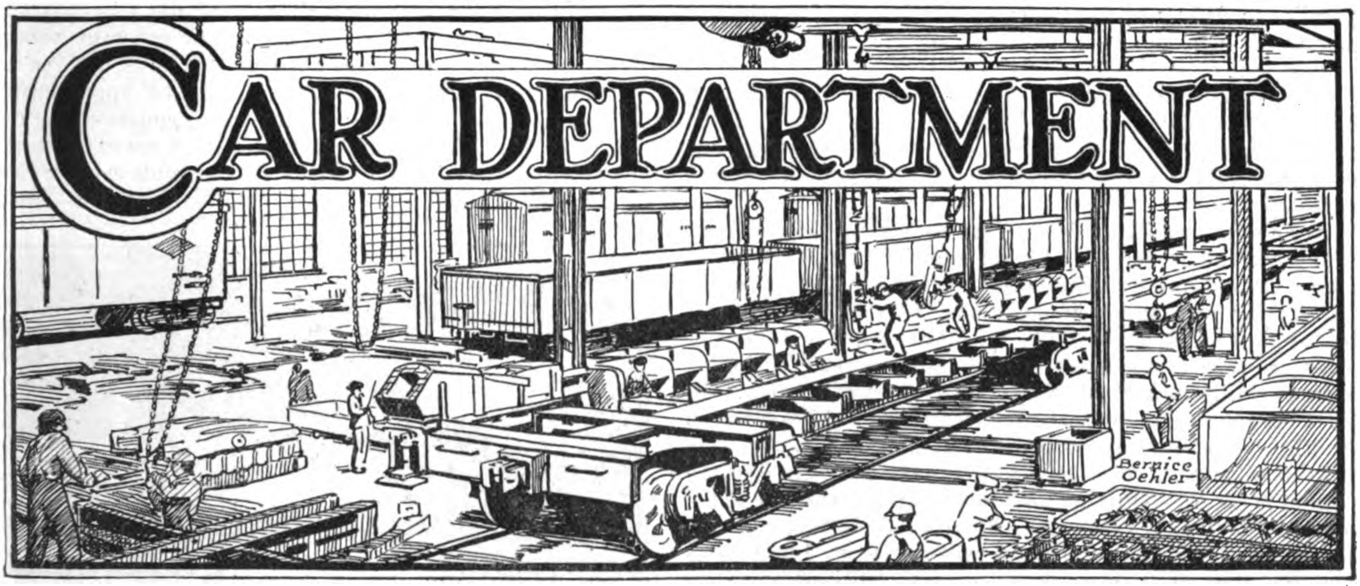


Fig. 6—Method of Determining the Back-Set of the Saddle Pin



Scrapping Steel Cars by Electric Arc Process

Facilities and Methods Which Are Applicable Where a Large Number of Cars Are To Be Handled

By A. M. Candy
General Engineering Department, Westinghouse Electric & Manufacturing Company

In the past it has been the practice to turn steel cars ready to be scrapped over to wrecking companies or car builders. As a result many thousands of dollars profits have been made by such companies which could be made just as

Fig. 1—Interior of a Building Equipped with Traveling Resistors for Use in Cutting Up Steel Cars by the Arc Process

well by the railroads if they would make the necessary capital investment to do the work. A few of the roads have already investigated this question and have put in efficient equipment.

The problem of handling cars to be cut up is divided into two quite distinct fields, namely, reclaiming and scrapping. When a car is in such condition that the side stakes and underframe are in a satisfactory state of preservation, the car is a subject for reclamation, the work required being that of cutting rivets and bolts so that the defective plates and fittings can be removed readily and new material re-riveted in position. In many instances, however, the cars are in such poor condition that the only salvage will be trucks, air brake equipment and possibly center sills. Such a car, therefore, is a straight scrap problem and can be disposed of much less expensively by straight away cutting of plates, stakes, angles, sills and other parts.

There are three general methods employed for cutting up steel cars, namely, air guns or "rivet busters," oxy-acetylene cutting torches and the electric arc. It is not sufficient to say that any one of these processes is the best or the cheapest, because it will be found that there is a field for each. Insofar as the actual operating cost is concerned, the arc process, however, is actually cheaper. On one road the cost of cutting 200 rivets ¾ in. in diameter was found to be as follows:

Labor, 1 hr., 3 min. at 90 cents an hour	$0.945
Electric power	0.800
Backing off rivets	0.660
Total	$2.405

A typical installation for reclaiming cars using the arc process for rivet cutting is shown by Fig. 1. Platforms at a convenient height are provided along both sides of the cars so that the operators can readily reach all the rivets. The resistor through which each operator obtains his cutting current is mounted overhead on wheels on a monorail so that it can readily be moved along the length of the car by the operator. The cutting cable is supported by the resistor carriage which relieves the operator from dragging long cable leads over the floor. Four motor-generators operated in

parallel to deliver 1,000 amperes each, provide capacity for a total of eight cutters at one time, using from 400 to 600 amperes each.

The building illustrated is used exclusively for the work of cutting off the rivet heads. The cars are then removed to another building where the rivets are backed out by means of air guns, the old plates are removed and new plates riveted in position.

At another installation where cars are scrapped, some rivet heads are cut off but in addition sufficient cutting through the plates and angles is done, as shown in Fig. 2, in a building similar to that illustrated above, so that the cars can be switched under a crane way as shown in Fig. 3. The car sides are then knocked out by the crane operator, swinging a large skull cracker ball through the sides of the car. In a few minutes' time the car is reduced to the condition shown by Fig. 4 where a gang using a rivet gun is shown cutting the few remaining rivets necessary for the complete destruction of the car. Actual records at this plant show that ten men can cut up 36 cars per 22-hr. day. Individual records show that the various operators will cut from 1,800 to as high as 3,100 rivets 5/8 in. in diameter per 10-hr. day.

The time required to cut up a car depends entirely on the number of pieces into which the car is cut, or in other words the number of feet of cutting. In some instances as high as 240 ft. to 250 ft. of cutting is being done on 40-ft. coke cars, whereas by careful analysis this same car can be cut into

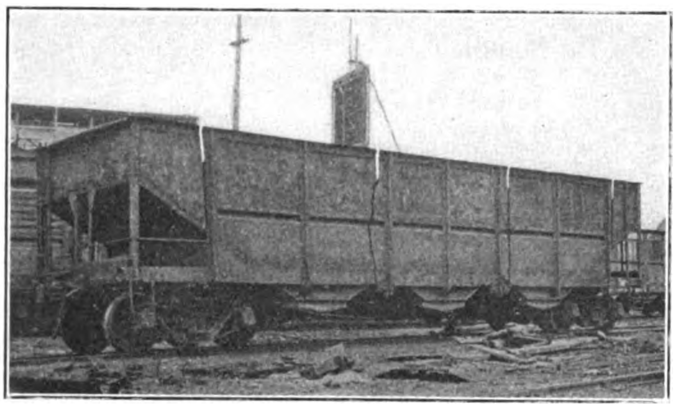


Fig. 2—Car with Rivets and Plates Cut Ready to Be Broken Down

14 pieces, involving 177 ft. of cutting, the pieces being sufficiently small to load in a car. This cutting can be executed by one operator in 3½ to 4 hours' time, the cost of labor and power not exceeding $6.75 to $7.00, based on labor at 60 cents an hour and power for the motor generator equipment at 2 cents a kilowatt-hour.

The size of the pieces into which a car must be cut is entirely dependent upon the material handling facilities of the company receiving the scrap. In some extreme cases, it will be found permissible to cut a car straight through from side to side, cutting it into three or four sections, the sides of which can be mashed over against the bottom where a crane is available to swing a skull cracker ball or an old truck.

One railroad has found that it is only necessary to cut hopper bottom cars at the corners and around the sides just above the bottom, leaving the sides, ends and bottoms full size, approximately as follows: Sides, 30 ft. 5 in. long by 9 ft. wide; bottom, 30 ft. 5 in. long by 9 ft. 6 in. wide; ends 9 ft. 6 in. long by 4 ft. wide. Gondola cars are cut at the corners and the sides and the bottom is cut across the center, making the sizes of the parts approximately as follows: Sides, 20 ft. long by 4 ft. wide; ends, 9 ft. 6 in. long by 4 ft. wide; bottoms, 20 ft. long by 9 ft. 6 in. wide.

When planning an electrical installation for rivet cutting or car scrapping work especial consideration must be given to the distribution system on account of the relatively high current values used and the relatively low generator voltage. Each cutting arc will be operated at 400 to as high as 800 amperes and the generator voltage will be approximately 60 volts. Where a number of cutters are employed the current to be handled will, therefore, run into several thousand amperes which will require the use of ample copper cable to keep the voltage drop within permissible limits—not to

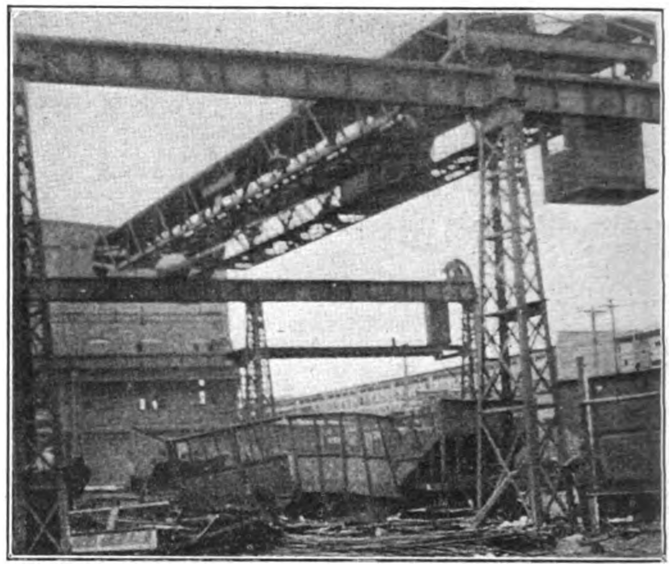


Fig. 3—Breaking Down the Car Body with a Skull Cracker

exceed 5 per cent of the generator voltage at the point where each arc is to be used. When the track is to be used as a part of the transmission system all joints must be heavily bonded. In some installations no special provisions are made for conducting the current from the car body to the rails but it is allowed to flow through the truck center bearings, journals and wheels to the track. This, however, in some cases at least, is not entirely satisfactory and results

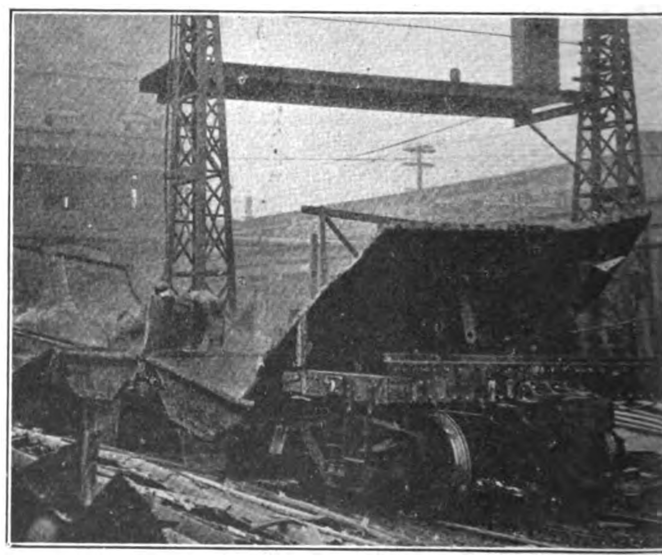


Fig. 4—Cutting the Few Remaining Rivets in the Hoppers with Pneumatic Hammers

in unnecessary loss as the voltage drop through the truck center bearings is considerably higher than at any other part of the car body.

To assist the operators in the cutting work it is advisable to have suitable scaffolding or platforms provided along the sides of the cars at a height of about 6½ ft. Each operator

will require a cutting resistor which will have considerable weight. Therefore, it is advisable to locate a number of these resistors on about 40 ft. centers under the platform so that they will be protected from the weather. A suitable terminal should be provided at the resistor so that each operator can readily connect his cutting holder cable to the resistor.

The motor-generator and switchboard equipment should be located in a building which will give the apparatus complete protection from the weather. This also centralizes the equipment so that it can be given the proper attention by a competent electrical attendant. It is usually advisable to install two or more motor-generators of say 1,000 amperes capacity each, to be operated in parallel when the current required is in excess of 1,000 amperes rather than one large machine, for several reasons. First, if one machine should fail, the plant can still be operated at a reduced capacity. Second, such a plant can be operated more efficiently because if the work for a given day demands only a portion of the available capacity, only a portion of the sets need be operated.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will prrint abstracts of decisions as rendered.)

Superstructure of Car Telescoped

While the St. Louis Southwestern's train No. 760 was entering Valley Junction Yard, October 21, 1921, the engine broke loose from the train, which consisted of 86 cars, causing the brakes to apply in emergency. The sudden stop resulted in the breaking of eight longitudinal sills in C. & N. W. car No. 76822 and Pennsylvania car No. 70691. The sills of both cars were broken at the transom of the adjoining ends. The broken sills on the Pennsylvania car dropped sufficiently to allow the coupler to foul the tie. The continued movement caused the coupler to act as a lever which raised the car sufficiently to permit it to pass over the broken sills of the C. & N. W. car, which demolished the superstructure for a distance of approximately 10 ft. from the end. No repairs were necessary on the head car in this train, and none of the wheels left the rails when the accident occurred.

The St. Louis Southwestern requested disposition under Rule 120. However, the Chicago & North Western stated that it had received information from the Pennsylvania, whose car was also involved in the accident, which indicated that its car had been telescoped. It, therefore, requested counter billing authority to cover the cost of repairs, less the cost of improvements, according to Rule 32. However, the St. Louis Southwestern contended that the car had failed by reason of an emergency application of the air brakes, which, according to the rules, did not constitute unfair usage and was, therefore, the owner's responsibility.

The Arbitration Committee decided that telescoping of the superstructure of the car above the sills, due to the mounting of another car, constitutes unfair usage, for which the handling line is responsible. The contention of the car owner was sustained.—*Case No. 1282, Chicago & North Western vs. St. Louis Southwestern.*

Wrong Repairs Should Be Corrected Within Nine Months

On October 8, 1919, Chicago Car Interchange Bureau defect card No. A-285,199 was issued against the Chicago & North Western for one pair of cast iron wheels in place of wrought steel wheels, box four, B. & L. E. car No. 80,536. This car was first delivered home, after the issuing of this car, by the Pennsylvania on January 12, 1921. It was shopped for the correction of the wrong repairs and for other defects, and was then moved to Enterprise mine siding January 19, 1921, where it remained until January 3, 1922. The car was then moved to the Greenville, Pa., shops of the Bessemer & Lake Erie, where the wrong repairs were corrected, January 19, 1922. A bill was rendered in the January accounts of the B. & L. E. against the C. & N. W. for $122.40, in which neither the application of the wrong wheels to the car, nor any allowance for credit for service metal was recorded. The Chicago & Northwestern refused to pay the bill, contending that the wrong repairs must be corrected within nine months from the first receipt of the car on the home line. The Bessemer claimed that its bill was correct on the ground that the first paragraph of Rule 87 specifically exempted cases provided for in Rules 57 and 70, and that the delivering line was responsible under Rule 70 and should pay the cost of repairs, inasmuch as the bill had been rendered within two years from January 12, 1921.

The Arbitration Committee, in sustaining the claim of the C. & N. W., decided that the exception of Rule 70 as referred to in Rule 87 means that the railroad violating Rule 70 is responsible to the line to which it delivers the car and not responsible to the car owner exclusively, and that the case was clearly one of wrong repairs, which should have been corrected within nine months after the first receipt of the car on the home line to justify the bill on the defect card.—*Case No. 1272, Chicago & North Western vs. Bessemer & Lake Erie.*

Joint Evidence of Wrong Repairs Filed Too Late

On July 20, 1920, the Southern Pacific at San Jose, Cal., rendered a repair card, according to Rule 60, to cover the cost of testing and stenciling the cylinder and Westinghouse K-2 triple valve on A. T. & S. F. car No. 48047. The car arrived home on August 24, 1920. On January 22, 1921, the Santa Fe shopped this car at Los Angeles. Here the car was found to have an H-49 triple valve that bore the stencil "S.J.—7-20-20—S.P. Co.," instead of a K-2. A joint evidence certificate was executed by a joint inspector, and an inspector for the Santa Fe. On May 4, 1921, this certificate, supported by the San Jose repair card, was sent to the Southern Pacific with a request that it be furnished a defect card. In December, 1921, as provided by Rule 13, codes of 1920 and 1921, the Santa Fe rendered a bill to the Southern Pacific for $16.58 to cover the cost of restoring this car to standard. This bill was also supported by copies of the joint evidence certificate, the Southern Pacific repair card of July 20, 1920, and the Santa Fe repair card of January 22, 1921, showing that the wrong repairs had been corrected.

The Southern Pacific refused payment on the ground that its San Jose repair card showed that a K-2 triple was tested and stenciled and did not show the application of an H-49, and therefore, it was not responsible for wrong repairs.

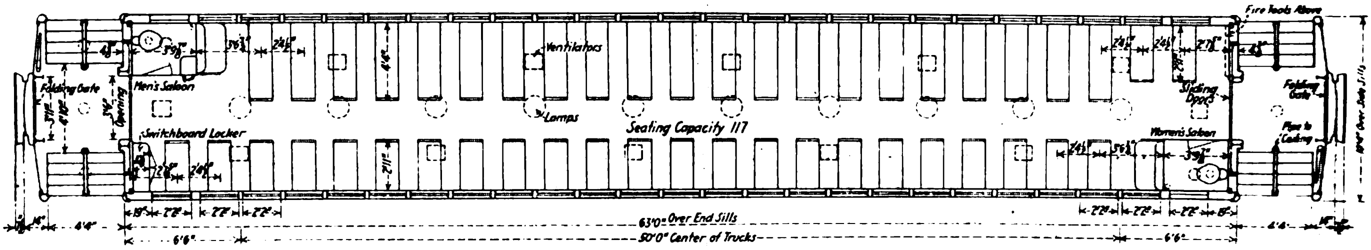
The Arbitration Committee decided that it is not evident that the Southern Pacific is responsible for the wrong triple valve in this case; and that if the wrong triple valve was in existence when the car was received home on August 24, 1920, joint evidence should have been obtained within three months, as required in Rule 12.—*Case No. 1285, Atchison, Topeka & Santa Fe vs. Southern Pacific.*

Steel Suburban Cars for Missouri Pacific

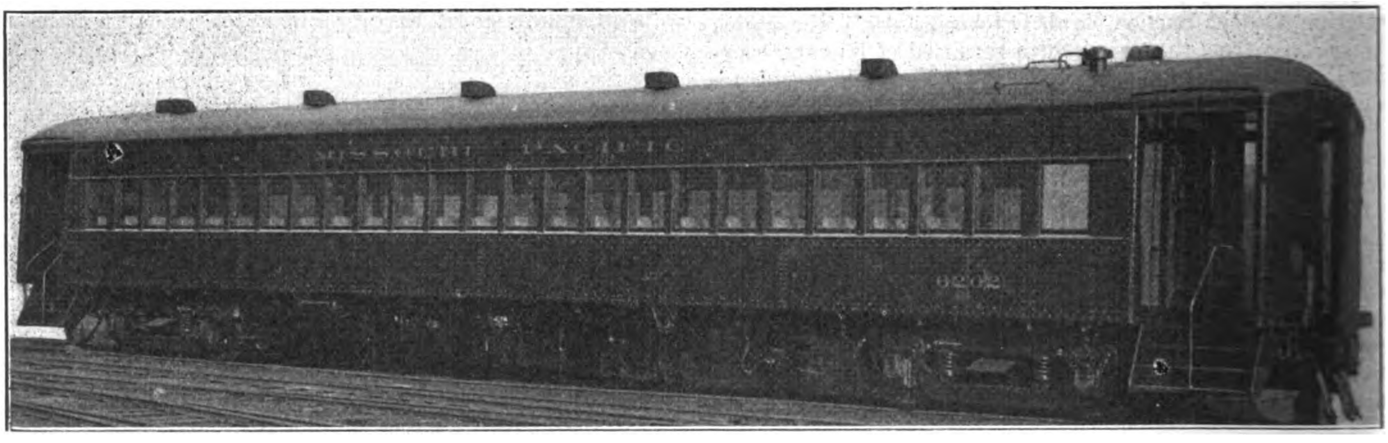
The Unique Seating Arrangement Provides for 117 Passengers with a Weight of 1,000 Lb. Each

THE Missouri Pacific has recently received 13 new suburban coaches and four combination suburban passenger and baggage cars from the American Car & Foundry Company. This equipment is intended for service between St. Louis and outlying suburban points.

The suburbs in the St. Louis district are only a few miles from the heart of the city, and it was decided that the utmost seating capacity with convenient facilities for promptly loading and unloading were demanded by the conditions. The seats, which are of the Walkover type, manufactured by the American Car & Foundry Company, are divided so that the long crossover seat holds three passengers and the short crossover seat has ample room for two passengers. The longer seats are 4 ft. 4 in. in length and the shorter ones 2 ft. 11 in. in length. The aisle, therefore, is off the center of the car. It affords ample space for passengers to move two abreast without undue interference. The seats have no arms, which adds considerable to the ease of passage through the aisle and of entrance into the seats.



Floor Plan of Missouri Pacific Suburban Coach Seating 117 Passengers



The Seating Arrangement on These Cars Provides a Long Crossover Seat for Three Pasengers and a Short Crossover Seat for Two Passengers

Cars Equal Through Passenger Coaches in Strength

The cars are of steel construction throughout, with steel interior finish, except for Agasote headlining and wainscoting. The underframe and superstructure details have been so designed that their strength is equal to that of coaches in through passenger service.

The center sills consist of two 12-in., 35-lb. channels, having top and bottom covers of ⅜ in. open hearth steel plates riveted to the flanges. Cast steel double body bolsters and platforms make up the two ends of the underframe construction. The side sills are 6-in. by 6-in. by ½-in. rolled steel angles, extending in one piece from end sill to end sill. The side and center sills are tied together with two deep crossbearers, consisting of 5/16-in. pressings placed back to back and provided with top and bottom cover plates of 10-in. by ½-in. open hearth steel.

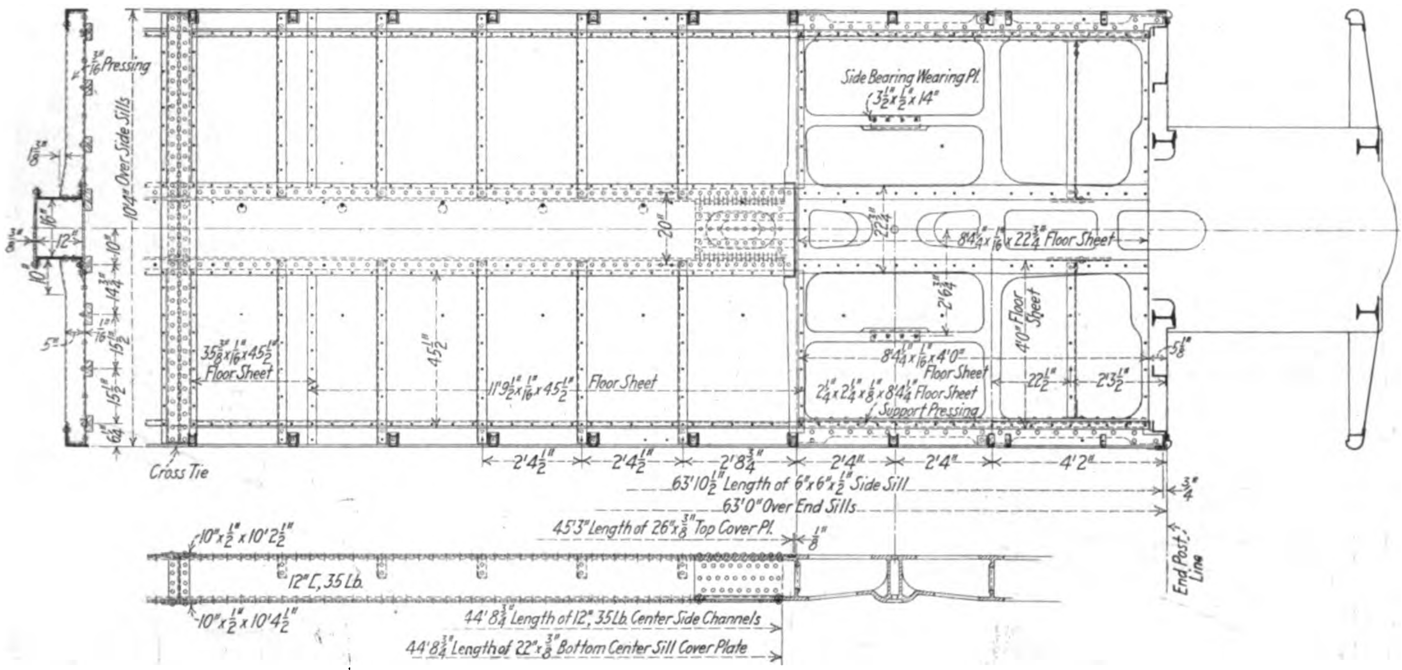
The floor supports, spaced approximately 2 ft. 4½ in. apart, form additional underframe members and consist of 3/16-in. pressed steel diaphragms. The side girder construction is made up of 3/16-in. rolled steel plates; it has for its lower chord a side sill angle of 6-in. by 6-in. by ½-in. section and utilizes as its upper chord the belt rail member, composed of a 4-in by ½-in. steel plate applied the full length of the car. On the inside of the side girder web are placed 2-in. by 2-in. by ¼-in. angles, which form an additional member of the top chord. The side posts are ⅛-in. channel-shape pressings, offset for the side sill and the side plate.

Turtle-Back Roof Applied

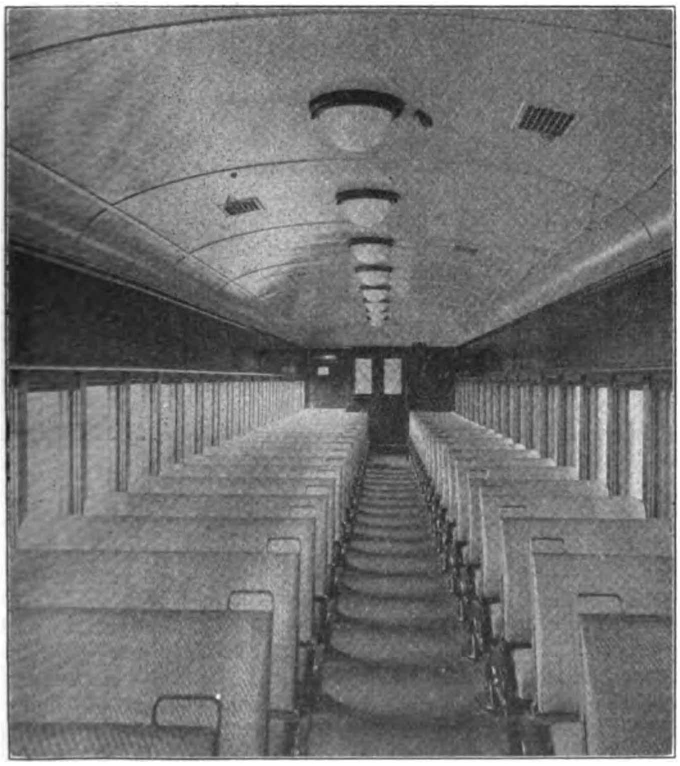
The roof is of the turtle-back type. It has side plates of 4-in. by 8.2-lb. Z-bars supporting open hearth steel angle carlines of 3½-in. by 2½-in. by ½-in. section. Two purlines, consisting of 2½-in. by 2-in. by 3/16-in. open hearth steel angles, are used in this roof construction. The roof is of poplar 13/16 in. thick by 3¼ in. face width, covered with canvas. Between the canvas and the wood roof is placed a felt roofing paper and as a preservative, the underside of the canvas is given a coat of paint. The canvas is secured with copper tacks and the outside has three coats

of an approved outside canvas roof preserver. The roof is provided with 12 Utility honeycomb type ventilators, with registers on the interior.

Double windows are used in these cars with each outside sash fitted with O. M. Edwards window fixtures. Rex weather stripping is applied to four sides of the outside sash. A sash raised sufficient to secure a distance of 46 in. from the floor line to the bottom of the sash enables seated passengers to have an unobstructed field of vision. Seats are spaced so that each passenger is opposite a window, giving opportunity for ample light during the day.



Underframe Construction of the Missouri Pacific Steel Suburban Cars

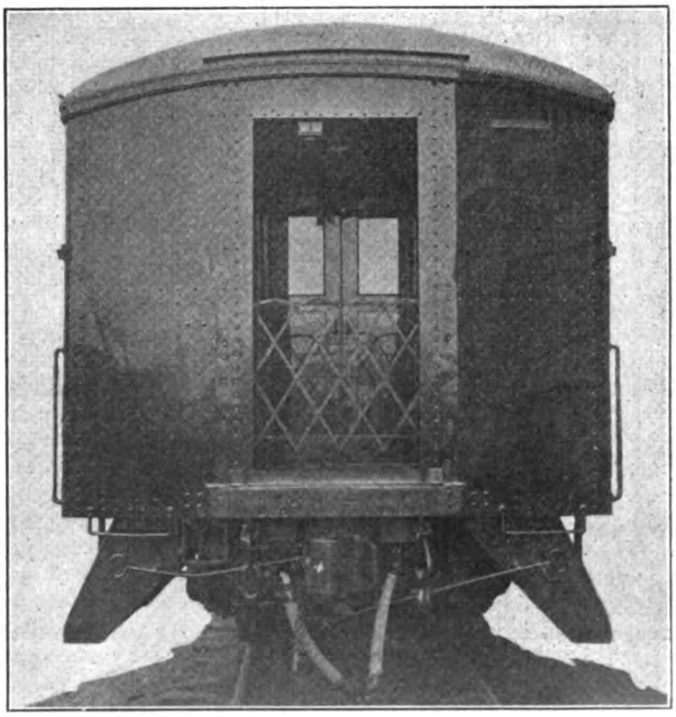


The Seats Accommodate Three Passengers on One Side and Two on the Other; Ample Light Is Provided for Reading

The cars are well insulated, having one course of 1-in. hair-felt and one course of 3-ply Salamander under the entire floor area. On the sides and ends against the outside sheets is placed one course of 3-ply Salamander, which is applied after the inside of the steel has received a coat of paint.

Careful Attention to Lighting Arrangement

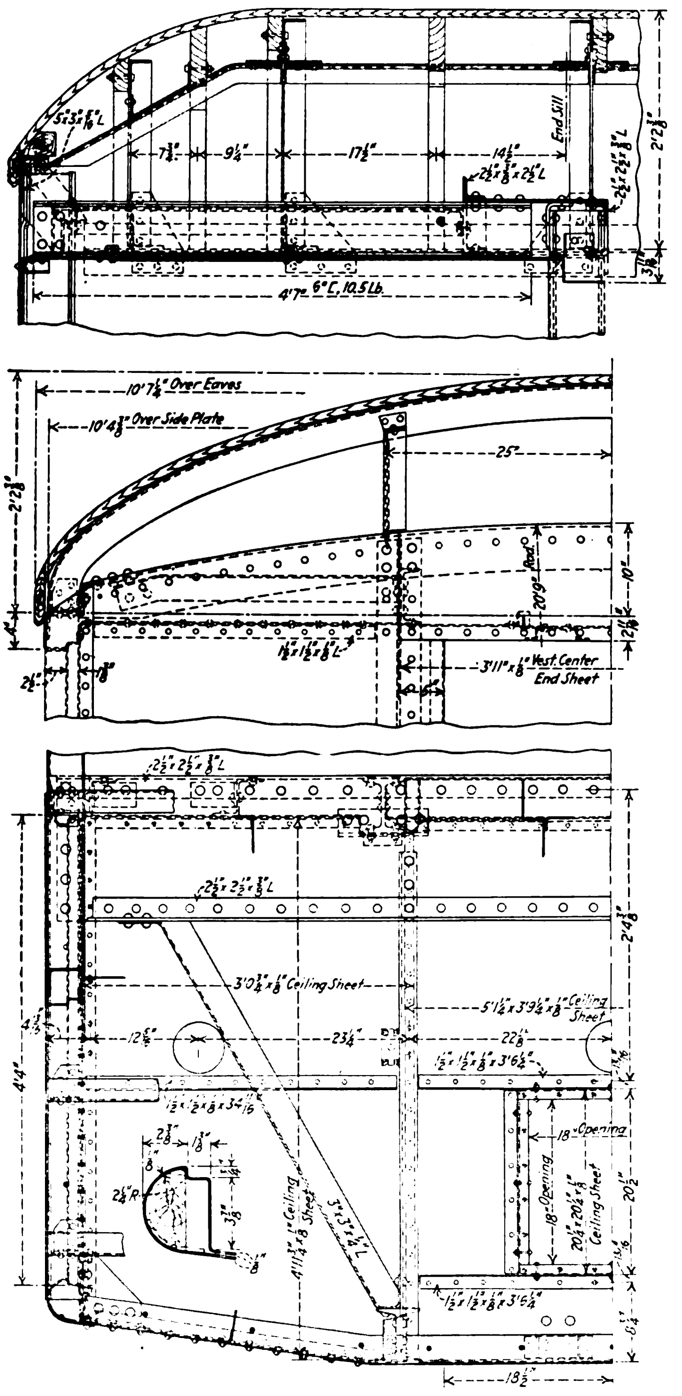
To facilitate reading, the lighting arrangement for these cars has been carefully planned. Along the center of the low-arched ceiling are placed 10 attractive center lamps. The head-lining is finished in a cream color down to the frieze molding. This combination of a low-arched, light



End View of the Car, Showing the Wide, Individually Operated End Doors

colored ceiling diffuses the light so that passengers can read comfortably. The extra wide platforms require well distributed light, and three vestibule lights are used on each platform. Current for the lamps is furnished by a 3-kw., 40-volt, 75 ampere generator, and each car is provided with an Edison 24-cell storage battery.

The latest system of vapor and pressure steam heat is used in the cars, designed to maintain at all times a com-



Longitudinal (at the Top) and Cross Sections of the Vestibule Roof Construction and Plan of the Bulkhead

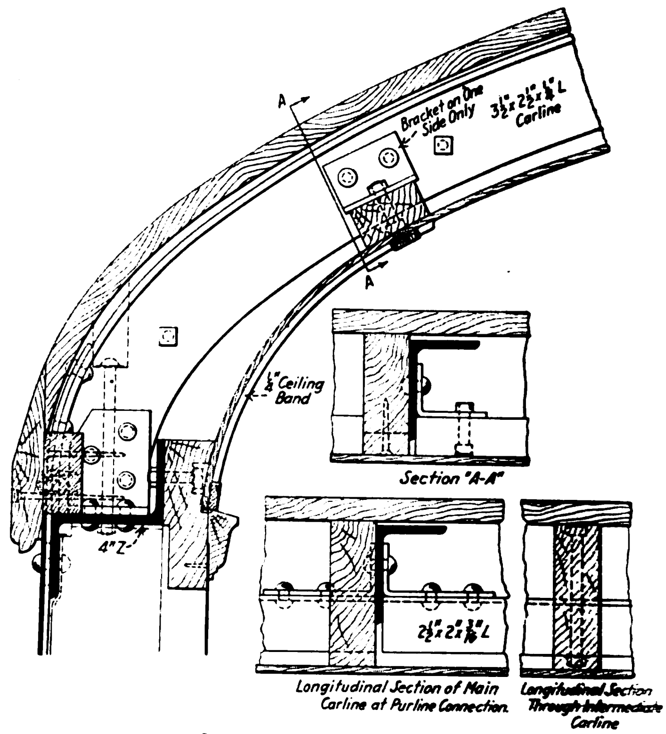
fortable temperature on the interior. Each car is provided with a Giessel sanitary water cooler of 11 gal. capacity. The water supply for the cars is taken care of by an overhead copper tank located at each saloon. The cars are equipped with the Westinghouse Schedule UC-1-1612 air brake equipment and the American Brake Company's slack adjuster.

Four-wheel trucks are used, with the Commonwealth Steel Company's frames, equipped with Simplex clasp brakes. The wheel base is 8 ft. long and the wheels are of cast steel, 36 in. in diameter. The journals are 5½ in. by 10. in.

Ample Room Provided for Entrance and Exit

The platforms are exceptionally wide, having an opening of 4 ft. 4 in. at the vestibule steps. A standing space of 25 sq. ft. is available. At the center of these steps a pipe railing is provided, which will allow of a continuous stream of passengers entering and discharging from the cars. In other words, the arrangement has been so worked out that persons getting off the car will not interfere with those entering the car. The vestibule steps have four treads.

It will be noted that this equipment and its appointments



Some of the Roof Details

correspond with the highest grade of coaches used on through passenger trains. The interior presents an exceptionally neat appearance, and the low-arched roof gives the effect of spaciousness throughout the car. The interior is finished in mahogany color, and statuary bronze trimmings are used throughout. The exterior presents a smooth, uniform appearance, an effect which is secured by the wide letterboard and uniform window spacing.

All the doors in these cars are of steel construction. The end doors are double, of the sliding type, with stationary glass in each door. They are so arranged that each one may be operated independently.

The empty weight of these cars is 118,000 lb. With a seating capacity of 117 persons the weight per seated passenger is slightly over 1,000 lb. A modern steel coach for through train service weighs approximately 135,000 lb., and figuring a seating capacity of 88, the weight per seated passenger is approximately 1,500 lb. This car, therefore, is approximately 500 lb. less in weight per seated passenger than the ordinary coach.

The over all length of the cars coupled is 74 ft. 9 in.; the height from the rail to the top of the roof at the center is 13 ft. 6⅛ in.; the height from the rail to the side of the eave molding is 11 ft. 2 5/16 in.; and the height from the rail to the bottom of the side sill is 3 ft. 7 11/16 in.

These cars were built at the St. Charles, Mo., plant of the American Car & Foundry Company.

Making Foremen in the Car Department*

Records Can Be Kept of Each Man Considered Eligible for Promotion to Assure the Proper Selection of Competent Supervisors

By C. J. Nelson
Assistant Master Car Builder, C. & N. W., Chicago

THERE is nothing more important in connection with car department work than the selection of the right kind of men, so far as possible, for supervisory positions. Also, we are guilty of serious negligence and injustice to our superiors if we fail to do all within our power towards elevating only such men as can fully qualify for these positions.

Some railroads prepare men for supervisory positions by apprenticeships and special training methods, but other railroads, the great majority I believe, depend entirely upon selecting their supervisors from the ranks. With the latter method great care must be exercised in order to prevent giving preference to men who, by accident or otherwise, may be fortunate enough to gain special recognition for some extraordinary, meritorious act, fortunately timed to constitute what is sometimes called a "grandstand play." This may seriously mislead the man's superiors into making him a foreman when he lacks the qualities essential for the genuine leader and efficient supervisor.

Applications for Supervisory Positions

District, or division officers, general foremen and foremen are earnestly desirous of locating the most valuable supervisors for the companies they represent and to accomplish this purpose the following plan is offered for consideration: District or division officers should by circular letter, preferably posted on bulletin boards, inform all employees under their jurisdiction that they may make application to their respective general foreman or foreman, for supervisory positions. This letter should clearly specify what qualifications are required, and it can be so worded that employees who are not qualified and never can qualify, will readily understand their limitations and not file applications.

Questionnaires, covering all the information that may be desired from applicants, should be available in the general foreman's or foreman's office, and when an employee desires to file application for a supervisory position, the questionnaire should be turned over to him, and both questions and answers filled out on another sheet of paper in his own hand writing. In other words, the questionnaire should be used only as a guide in writing the letter of application. The general foreman or foreman to whom applications are made should then pass judgment on them and if for any reason an applicant is not desirable, he should be told exactly wherein his failings lie. Perhaps he has weak points that can be overcome, and if so these should be pointed out by his foreman, and the acceptance of the application deferred. If, however, the foreman decides that the applicant is satisfactory, the application should then be approved and forwarded to the district or division officer, together with a letter from the foreman giving a complete history of the applicant's record, qualifications, etc.

Before the application is approved by the foreman, however, he should know beyond any doubt that the applicant has not been guilty of attempting to mislead or misrepresent the facts in his application. He should be positive that the man has the qualifications necessary for a desirable leader.

The district or division officer to whom the application is sent should, by recheck, substantiate the information furnished and, if possible, become personally acquainted with applicant if he does not already know him. All fully approved applications should be kept on file in the district or division offices and some system maintained whereby division officers will at all times know exactly which applicant is in line for the next promotion. It would no doubt be advisable as a matter of encouragement to let the men know when they are in line for promotion, as this will have a tendency to spur them on to greater efforts and in all probability increase their value to the car department. In addition, these men should be assisted and given every opportunity to fit themselves more fully for whatever position of authority they will some day be called on to fill.

No other class of railroad work is any harder to master than that of car building or repairing, with its wide scope, many exacting details, and problems due to rapid change and development in the details of car design. It is practically impossible to secure car department supervisors with college educations and training, who at the same time have the necessary practical training. In fact, experience shows that a college education is not necessary to attain and retain some of the highest positions in the car department as well as other branches of railroad work. Certainly, however, it would be unwise to promote men to supervisory positions if they have not had a fairly good and well absorbed education.

Besides education, the men in line for foremen's positions should possess such additional assets as honesty, reliability, soberness, diplomacy, determination, enthusiasm and a feeling of loyalty toward their foreman and railroad. It is also important that they have a good understanding of men, and a pleasing personality. The quality of "broadness" was omitted from this list, through a desire to emphasize its importance. A leader who is lacking in this virtue and who is contaminated with the slightest degree of narrowness (always discernible to the scrutinous eyes of his subordinates) can never render his employer one hundred per cent service. His judgment of men will be distorted and his influence with them ended.

With this outline of the kind of men desirable for car department leadership kept in mind, I believe it would not be amiss for all of us who have already been entrusted with responsible positions to take stock of ourselves and ascertain how near we come to possessing all the qualities that we expect of those to whom we should be a shining example. Probably all of us will find opportunities for self-improvement. Similar thoughts have no doubt come to your minds

*Abstract of a paper presented at the February meeting of the Car Foremen's Association of Chicago.

in one way or another many times, but the subject of foremen selection is so very important that it can not too often be dwelt upon or discussed. If these words have had no other effect than being instrumental in starting just one good man towards the front line who would otherwise have been condemned to obscurity, I shall feel rewarded for my effort.

Qualifications of Car Inspectors

Next in importance to foremen, in my judgment, are the car inspectors and while they are perhaps ridiculed and criticized more than any other class of employees in the car department, or in fact on the railroad, yet I am sure you can conscientiously join me in paying respectful tribute to them as a whole, for the splendid work they perform under the most trying conditions. I doubt if we stop often enough to consider the numerous times they voluntarily risk their lives in order to protect their respective companies, its employees and the traveling public, nor do we appreciate as we should the many thousands of defects they discover as compared with the very few they overlook, which is evidenced by the small percentage of unit failures en route. The importance of selecting men for this exacting work cannot well be over emphasized as exceptional intelligence, loyalty and physical perfection are necessary for the proper performance of this class of work.

All car inspectors should be sufficiently well versed in the English language to enable them to understand and memorize all instructions issued to them, as well as the many rules with which they must be familiar; also, good penmanship is necessary in order to insure that the many important records and reports they are compelled to make in connection with their duties, be distinct and correct. In addition to this, they should have sufficient car repairing experience to have gained a thorough knowledge of car construction and anatomy which is essential for good judgment in handling the many problems requiring quick and sound decisions. It goes without saying that eye-sight and hearing must be perfect, also that their physical condition must be such that all duties can be properly performed regardless of weather conditions. It is during severe weather that the metal of an inspector is put to the test, and I would like to devote more space than permitted in this paper, in commending the loyal men, of whom I am glad to say there are many, who never flinch in the face of the severest kind of heat, cold or storm. It seems to me that the men who are doing this work faithfully, should have no hesitation in protesting against those who are not, knowing as they must the terrible consequences that might be the result of such shirking of duty.

In car inspection work there are more opportunities for the men assigned to it, who are so disposed, to shirk their duties without immediate detection, than in any other line of railroad work. It naturally follows, therefore, that we must depend almost entirely upon the honesty and loyalty of these men, and, knowing as previously stated that we have many such men engaged in this capacity, I feel safe in suggesting that a thorough analysis will reveal characters among them which can give an excellent account of themselves in higher positions of responsibility.

My appeal for your consideration of car inspectors is most sincere, being influenced to some extent probably by the fact that I personally served about ten years as a night inspector. I mention this not as a boast, yet with considerable satisfaction, for this severe schooling has been more helpful to me in the work I was subsequently assigned to, than any other experience I ever had.

Anticipating that this paper will be read by several hundreds of car inspectors, I wish at this time most earnestly to remind them of one of the most important things in connection with their work, of which I am sure they are fully aware but which is too often forgotten, and that is never to permit your mind to wander from your work while engaged in inspecting cars for safety. No matter how proficient a man may be, he can look directly at the most dangerous defect at times, and if his mind is not thoroughly concentrated on his work, may not notice the defect at all. I fully appreciate how difficult it is to keep the mind concentrated for several hours on one job in spite of the best intentions, and it is therefore urgently recommended that when one or more cars have been inspected with your thoughts elsewhere, you look them over again, if it can be done.

Gaging Wrought Steel Wheels for Car and Tender

Part II—Discussion

Discussion of Paper by Arthur Knapp on Use of New Steel Wheel Gage for Inspection and Billing

THE paper by Arthur Knapp, assistant to the consulting engineer, New York Central, which was presented at the December meeting of the Car Foremen's Association of Chicago, and given in the March issue of the *Railway Mechanical Engineer,* contained much valuable data on the use of the new A. R. A. steel wheel gage for determining defects, turning wheels and making out bills. An abstract of the discussion on this important paper is given herewith:

Mr. Mehan (C., M. & St. P.): For the purpose of having this matter made clear, we will say that this gage is placed on the wheel as explained. If short leg is not movable so that when the gage is put up against the side of the wheel in that way, and if the lowest point of the tread is over here it will throw your calculations out of order.

Mr. Knapp: That may be true, but in going over thousands of wheels it has been found that the wear is confined to one or two inches on the wheel tread. It is true that the tread and flange wear on a steel wheel would vary to a certain extent, but only one wheel, possibly, out of a thousand will wear away to any considerable extent outside the zone of application of the gage.

Mr. Mehan: Placing the finger against the worn flange it will indicate how much is to come off the tread in order to get in full flange contour. How do you indicate the service metal remaining where you don't turn tread and flange all the way and cut the witness groove into the flange? I am assuming that the witness groove is to be cut into the flange only in such cases as it is unnecessary to cut tread and flange to full A. R. A. contour.

Mr. Knapp: The calibration of the gage is on the safe side; that is, the calibration is based on the average form of tread wear. In the practical application to shop work we have instructed the N. Y. C. shops so that the operator will adjust his lathe to take a cut 1/16 in. less for the rough cut than the gage reads, and then depend on the finishing tool to produce the proper form of tread and flange contour. No two wheels wear exactly alike, and no gage can be designed that will cover every condition.

Mr. Mehan: When turning the witness groove in flange will it affect the contour of your tread?

Mr. Knapp: If the witness mark is larger than permitted under A. R. A. Rules you will have to take a second finishing cut to bring the contour to the proper form.

Mr. Mehan: Is it the intention to use this new gage in measuring service metal on steel tired wheels, and if so, just how is the gage to be used on such wheels?

Mr. Knapp: Because of different types of wheel centers the only way to control the rim thickness on steel tired wheels is to confine the measurements to the front rim face and base those measurements on the limit of wear groove, and in doing that we must use the gage as illustrated in Fig. 3 and read the graduations down to the limit of wear on the front face of the tire.

Mr. Petran (C., M. & St. P.): How does the N. Y. C. reconcile themselves to the rolled steel wheels when they place the gage on the back of the flange and take the measurements? The rolled steel wheel is not turned back and varies in thickness.

Mr. Knapp: That is the reason we have recommended that measurements be taken at two points.

Mr. Petran: Do they mark them with a chalk line?

Mr. Knapp: It is not necessary. The man who makes that measurement, if he is a lathe operator, can tell what should be done.

Mr. Petran: Don't you think there are lots of tires when if you look for the lowest point on the tread you will find the wheels out of center?

Mr. Knapp: There will be variation, but it does not necessarily mean that the wheels are out of center. The only way we can correct that particular feature will be when the wheels now in service are worn out. New wheels purchased under A. R. A. specifications have all these dimensions carefully guarded, as the new specifications specify that wheels must be round in the back within 1/8 in. and the difference between back and front must be within 1/4 in. in diameter. The front face must never exceed the back face in diameter.

Mr. Petran: We found in using A. R. A. gages that steel wheels seemed to be softer in spots and after running a certain period frequently the flange was out of true, yet the axle was true. The lathe operator will not always watch out for them, and as a result it will often vary 1/8 in. before turning and after turning. It is due to the man not finding the lowest spot on that wheel. In reclaiming wheels, we have a lot of ballast cars and work cars which remain on our road. All wheels condemned for passenger or freight service when given the last turning are put under these cars, and we find them four times superior to cast wheels, and when they are worn down they are scrapped.

Mr. Knapp: You find that the steel wheels that are worn down so they are condemned for passenger service will outwear four cast iron wheels in ballast car service?

Mr. Petran: Yes.

Mr. Knapp: Variation in rim thickness may be brought about by manufacturing practice. The flange thickness I am unable to account for. Flanges vary in thickness to a considerable extent. Sometimes I think that during boring the wheels are cocked a little in the boring mill.

Mr. Petran: We had that same condition. I would not want to blame the wheel. I believe the wheels originally were bored straight. I believe it was soft metal in the wheel that does it; some would have the flange egg shape. If it is not responsible for the egg shape neither is it responsible for the web and flange.

Mr. Mehan: At present we have been confined to a maximum of 1½ in. service metal in the rolled steel wheel. Do I understand that maximum has been increased, and if so, what is the new maximum?

Mr. Knapp: Steel wheels purchased under the former A. R. A. specification were subject to a tolerance in tape size of nine tapes over and five tapes under. That means that, for instance, a 33 in. freight wheel having a nominal tape size of 157 might vary up to tape size 166 or down to 152. With this variation the wheel rims were also permitted to vary in rim thickness to an extent of 3/16 in. under the specified thickness; namely, 2½ in. The specification required, however, that the average rim thickness per shipment must equal 2½ in. per wheel. Conditions of manufacture frequently resulted in the production of wheels of the same tape size with the rim of one wheel 3/16 in. under the specified thickness; while the mate wheel, i. e., a wheel with the same tape size, might have 3/16 in. in excess. It will be possible under this condition to mate wheels with a variation in rim thickness of 3/8 in. When removed from service, the condition of the wheel with the minimum rim thickness generally controlled the scrapping or re-application of the pair of wheels; and in this way the railroads were subjected to a considerable loss in service metal. With a 2½ in. rim we are able to use only 1½ in. in service, due to the specified condemning limit of 1 in. for passenger car and tender wheels. When that fact was considered by the committee, it was agreed that any tolerance affecting rim thickness should be worded to insure a full 2½ in. rim with any variation over rather than under. The new specifications require that any tolerance in tape size shall be over with none under, although the manufacturer has the same range for the variation usually experienced under manufacturing conditions. The change in this tolerance, with the requirements to insure a comparatively uniform interior diameter of rim, front and back, will tend to increase the amount of metal available in a wheel rim for service under passenger cars or tenders; and, of course, the change in condemning limits for wheels used in freight service will result in a further increase of service metal to the extent of 1/4 in.

Mr. Ripley (Chief Mechanical Engineer, A., T. & S. F., and chairman A. R. A. Wheel Committee): I want to express the appreciation of the Wheel Committee to you for taking up this subject. It is essential that you, who will actually use this gage, have a thorough understanding of its purpose and its functions. The difficulty in the proper measurement of steel wheels and billing for defects in same is one that has been recognized for years. The Arbitration Committee has had many cases brought before it, in regard to questions arising over billing, and the Wheel Committee was requested to attempt to remedy this condition. A great deal of time was expended in the study of this subject and in the development of the gage recommended. Mr. Knapp spent a great deal of time in studying the contours of worn steel wheels on the N. Y. C., and the credit for the final calibration of the gage belongs largely to him; though I may say that before deciding on the calibration, the committee secured figures from a number of roads located in different sections, in order to arrive at a fair average. The committee admits that it is possible to find occasional wheels with freak wear conditions on which the reading of the movable finger will be slightly incorrect. The maximum inaccuracy, however, will probably lie within 1/16 in., and these freak wheels will be few. In interchange the number of such wheels will probably be fairly well balanced. It is possible to make a gage which would measure all such freak wheels, but it would be so complicated that it would be impractical. The committee felt that the gage must be simple and one which could readily be understood. I believe you will all agree that the past practice of billing for metal in steel wheels has been unsatisfactory, and has not resulted in fair billing between roads. Theoretically, the only way we could make up a bill under the old rules, was to hold the bill until the wheel had been turned, and measurements taken both before and after turning. In actual practice it is almost impossible to keep track of all these wheels until

they reach the wheel lathe and records returned for billing. As a result bills have been made up largely on the basis of guess work. The committee hopes that this new tool will provide a simple method of making the bills on the repair track, just as bills for other materials are made. Before recommending this gage, the committee tried it out on a number of roads and all reports were favorable. However, they realize that in anything as radically new there are possibilities of certain weaknesses.

There is one question in connection with the use of this gage to which I call attention, as I fear there is a possibility of confusion arising. As Mr. Knapp stated, when measuring the thickness of metal in the tread of the wheel, the reading is taken on the vertical leg at the intersection of the underside of the back rim. Under the new specifications, this intersection will be a sharp line. However, on a number of older wheels you will find a rounded corner at this point. One manufacturer has taken a light cut to eliminate the sharp corner. When taking readings with this gage, it should be remembered that the proper point for reading is the theoretical intersection of the back face of the rim and the slope of the underside of the back rim. Therefore, if the corner is rounded inspectors should either sight the intersection of the slope with the leg of the gage or determine it by laying a straight edge or even his finger on this sloping underside of the rim.

While the committee has presented this gage as the standard for use in the Code of Rules, wording has been added in the Code to permit of the use of any other approved type. By approved gage, we mean one that has passed the approval of the Wheel Committee. They will be glad to consider any other type presented to them. They will insist, however, that it take all readings, in the same general manner as the A. R. A. standard gage, and that the calibration of the moving finger must be the same. This is absolutely essential if fair billing is to be maintained. One other such gage has already been approved.

This gage may also be used for flange height measurement by swinging the finger through an arc of 180 deg. and letting the back of this finger rest on the top of the flange. You can then place marks on the main body of the gage, indicating the intersection of the zero mark on the finger for the various heights of flange. The committee could not include this, because flange height requirements vary on different roads, but the gage has been so designed that the back of the moving finger will always rest on the apex of the flange, when in the reverse position to which I have just referred.

In addition to the use of this gage for condemning wheels and billing the use in shops is of vital importance. Mr. Knapp has called your attention to the great value of the metal in the tread of a rolled steel wheel. Few lathe men appreciate how much 1/16 in. metal is worth. In turning wheels they often take off entirely too much metal. Taking an extra cut usually results in their being called by the foreman for a waste of time, and they naturally take a sufficient cut to be sure and develop a full tread contour. The gage should put a stop to this wastage of metal, as the lathe operator can determine, before he takes his cut, exactly how much should be taken off to get the proper contour.

Mr. Lickey (N. Y. C.): I believe most turning flanges out of true is caused by wheel lathe drivers, perhaps two drivers on a side are the only ones doing the driving, thereby springing the axle.

Mr. Knapp: I would like to ask Mr. Lickey if they use a centering device at the lathe? I am anxious to hear wheel lathe operators talk about variation in flange thickness as it is hard to identify the point where that occurs. Some say it is warping of the wheels when purchased. All wheels are supposed to be examined with a plain gage, and I believe warping, even 1/16 in. can be detected. This, in my opinion, does not account for the variation in those wheels.

Mr. Radway (C., M. & St. P.): I have a wheel lathe in which the journals are held central by clips in the spindle, after which the chuck jaws come in contact with the wheel all at the same time and with equal pressure.

I often find as much as ⅜ in. difference between one side of the wheel and the other and in checking the outside contour against the hub contour and the bore, I find that there is a variation, showing that while the wheel was bored square with the flange, still the outside contour would not be concentric with the bore.

I understood the reader to say that they allowed 1/16 in. or on a reading of 5/16 in. they would remove ¼ in. of metal. That would mean that the roughing tool would leave a witness mark 1/16 in. deep, this 1/16 in. of metal to be removed by the finishing tool. I do not find this possible as our finishing tools slide over the hard glazed surface and will not stand up.

Mr. Knapp: We can do that. What kind of steel do you use in your cutting tools?

Mr. Radway: We use Rex double A high speed, but possibly Rex triple A might do the business.

Mr. Knapp: The statement is made that you cannot take 1/16 in. of metal off the wheel, using a roughing cut and a finishing cut. Some of our lathes are able to remove 1/16 in. or better with the finishing tools, while difficulty is experienced with other lathes. Should it develop that 1/16 in. is an excessive cut for the finishing tools, the wheel should be permitted to revolve for two or three revolutions if necessary to enable the operator to finish the treads and flanges properly. The slight increase in the cost of turning under that practice would be more than offset by the amount of metal saved and the better finish on the wheel tread and flange.

Mr. Kleist (B. & O.): I would like to ask if the table which the N. & W. has gotten up could be used in connection with this gage?

Mr. Knapp: Yes.

Mr. Davis: (Universal Packing & Service Company): The taping table is copyrighted by Bernard Cook of the N. & W., but he has turned the whole subject over to me. I would be glad to give copies to anyone interested.

Mr. Kleist: As I understand it, this new gage does not necessarily supercede the old gages in gaging flanges, etc., in interchange. The old gage can still be used on flanges to determine vertical or worn flanges.

Mr. Knapp: Most assuredly. I believe the man inspecting cast iron wheels will be called upon to use the old gage. The object of this gage is to determine how much must be turned off on account slid flat or worn flanges on steel wheels.

Mr. Kleist: Is it intended that this new gage be used generally by the inspector in the yard and at interchange points?

Mr. Knapp: It must be used by the inspector in sending cars with defective steel wheels to the repair tracks. They must use it also for gaging flat spots, or chipped rims and such defects. We have tried to design it so that it would not be necessary to carry two gages, but I do not know how you can get around this question of sharp flanges so far as cast iron wheels are concerned.

Mr. Erickson: As I understand it, this gage is to be used on repair tracks to determine the amount of metal to be turned off to secure proper flange and tread contour and furnish the necessary information to the billing clerks without holding the bill up until the wheel had been turned, but that it was not necessary for the inspector in the train yard to carry it as he would be able to determine whether or not the wheel was safe to be in service by the use of the old wheel gage for determining flange thickness.

Mr. Ripley: How can you determine whether it is neces-

sary to cut the car out for defective wheel if you do not carry the gage?

Mr. Knapp: They could use the former M. C. B. gage.

Mr. Ripley: The past practice in condemning wheels for thin tread has been questionable. Inspectors have no actual way of determining the tread thickness. It is true, there has been a limit of wear groove on the rim, but as a rule the tread is worn somewhat hollow. It is impossible to determine just how close to the limit of wear line the center portion of the tread actually is. They could use a scale on the outside edge, but this makes no allowance for the hollowness. The real danger point, so far as tread thickness is concerned, is through the throat to the underside of the rim on the back. There is no way of measuring this except with some such gage as proposed. It is therefore necessary that all inspectors carry the A. R. A. steel wheel gage or an approved equivalent, otherwise, they will not be in position to condemn or pass steel wheels, so far as thin rims are concerned. It should be remembered that wheels made under the new specifications will have no limit of wear line on the front side of the rim.

As regards the other features of the gage, such as the notches for measuring slid flats, chipped rims, and vertical flanges, etc. The committee merely added these to make the gage more useful for inspection. The old wheel defect gage is still the standard in the Code, but we felt that at times the inspector would only have the one wheel gage with him, and these additional features would make it particularly useful. It would take care of everything which the wheel defect gage takes care of, except the thin flanges on cast iron wheels. The back of a flange on a cast iron wheel is rounded, and therefore the leg of the gage cannot be set squarely against it, though, of course, it is possible to get an approximate measurement of the flange thickness.

Ventilation and Heating of Passenger Cars*

Part II—Heating

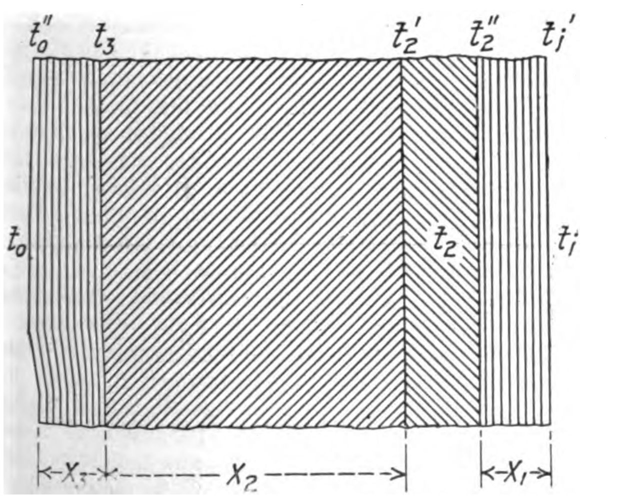
Analysis of Losses Through Enclosing Surfaces of a Typical Coach—Coal Used in Severe Weather

By K. F. Nystrom

Engineer of Design, Chicago, Milwaukee & St. Paul

Generally speaking, there are only two modern heating systems in use in passenger trains at the present time on the American continent: the hot water system and the vapor system.

The hot water system, which is a self-contained unit in each car, is almost exclusively used as an emergency or auxiliary item. This system has not proved satisfactory. It is costly to install, requires constant attention, is dirty, and easily put out of order in cold weather because the water



Sketch Illustrating Heat Transmission Through a Wall of Several Materials

freezes in the drums or in the pipes. It is also difficult to control. Moreover, it adds from 2,800 lb. to 3,500 lb. to the weight of the car. It is a necessity, however, for some equipment, such, for instance, private cars which may be stored at small stations where steam is not available.

The vapor system seems to give general satisfaction. Its basic principle is embodied in the reduction of the live steam furnished from the engine through the train line to atmospheric pressure at 212 deg. F. by passing through a vapor regulator located underneath the car. With this system there are no heating pipes within the car containing steam at a pressure higher than that of the atmosphere. The danger of scalding passengers from broken pipes is, therefore, eliminated.

Steam at atmospheric pressure always registers 212 deg. F., therefore with the vapor system the heating pipes in all the cars are at the same temperature, regardless of the pressure in the train line, which naturally varies from the front to the rear of the train.

The outside temperature in the winter months in Canada and the northern part of the United States occasionally drops down to 50 deg., or more, below zero. It seems, therefore, that when figuring insulation for passenger cars, a temperature of not less than 30 deg. F. below zero should be considered.

The inside temperature in a passenger car may be taken at 70 deg. F., and with the outside at 30 deg. F. below zero a difference of 100 deg. F. will exist between the inside and outside temperature of the car.

Heat Losses in a Passenger Car

The heat losses from the inside of a passenger car are caused by (1) conduction or direct contact, (2) convection by air currents and (3) radiation, as from the sun. Air currents within a wall, commonly known as dead air spaces, convey heat by convection only when the spaces are tight.

The loss of heat through walls is both in the nature of radiation and conduction. The principal loss is found to depend on the difference of temperature and is similar to conduction rather than radiation which depends on a higher power of difference in temperatures. The general form in which this heat loss is given is:

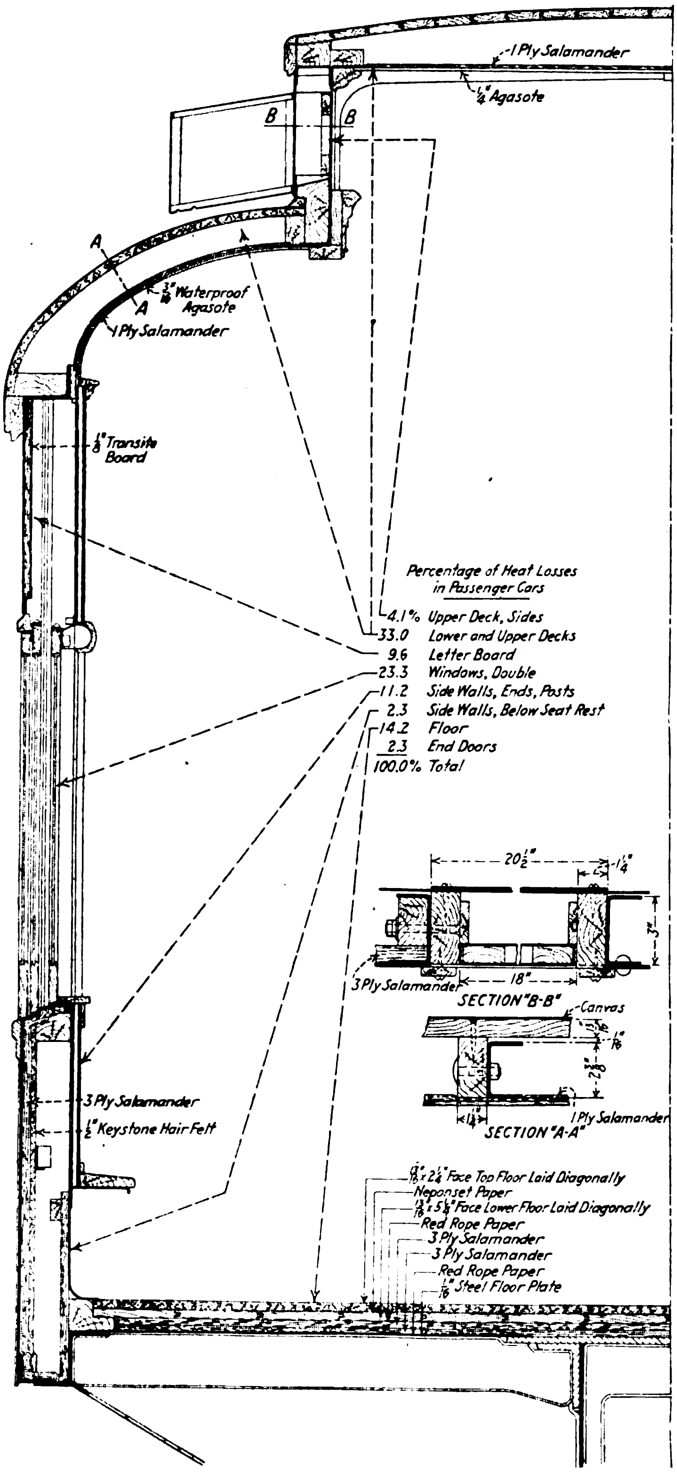
$$B = HA(t_i - t_o)$$

where A = area in square feet; H = heat transmitted per

*Abstract of a paper presented at the meeting of the Canadian Railway Club, held at Montreal, Que., February 12, 1924.

sq. ft. per hour per degree difference of temperature, in B. t. u.; t_i = room temperature in deg. F.; t_o = outside temperature in deg. F.; B = B. t. u. transmitted per hour. The value of H depends on several factors: the surface, thickness, and kind of material, air spaces and condition of air at surfaces.

The rate of transmission of heat through any substance depends on the thickness and on the difference of temperature. If, for instance, the wall, as shown in the accompanying drawing, is made up of several thicknesses and the temperatures as indicated, the equations for the transmission of heat through each section must each give the quantity of heat transmitted by the wall, and these, therefore, must be equal to each other.



Distribution of the Heat Losses in a Well Insulated Passenger Car

The amount of heat conducted by any material per square foot of cross-section varies directly with the temperature difference and inversely with the thickness. This gives

$$B = \frac{C}{x}(t_1 - t_2) \qquad (2)$$

where C is the coefficient of conductivity in B. t. u. per 24 hrs. for one inch thickness per square foot per degree, x is the thickness in inches and $t_1 - t_2$ is the difference of temperature. Using this for the wall shown in the sketch, it follows that

$$B = \frac{C_1}{x_1}(t_i' - t_2'') = \frac{C_2}{x_2}(t_2' - t_3) = \frac{C_3}{x_3}(t_3 - t_o'') \qquad (3)$$

At the surface of any material there is to be found a temperature different from that of the space around, and it is this difference which determines the flow of heat at the surface. If K is the coefficient of transmission, sometimes referred to as surface resistance, per square foot per hour per degree across the surface this becomes at different surfaces:

$$B = K_1(t_i - t_i') = K_2(t_2'' - t_2) = K_3(t_3 - t_3') = K_4(t_o'' - t_o) \qquad (4)$$

The values of B in the sets above are all the same, hence solving for temperature differences and adding, the following results:

$$B\left[\frac{1}{K_1} + \frac{x_1}{C_1} + \frac{1}{K_2} + \frac{1}{K_3} + \frac{x_2}{C_2} + \frac{x_3}{C_3} + \frac{1}{K_4}\right] = t_i - t_o \qquad (5)$$

$$H = \frac{B}{t_i - t_o} \quad \text{See formula (2)} \qquad (6)$$

$$H = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} + \frac{1}{K_4} + \frac{x_1}{C_1} + \frac{x_2}{C_2} + \frac{x_3}{C_3}} \qquad (7)$$

There seems to be no reliable data as to the actual combined coefficient of radiation and convection or the surface resistance designated K_1, K_2, K_3, etc.

The values for K at the inside of a wall varies from that on the outside. From tests made by L. C. Lichtz at the University of Illinois in 1915, it was found that the average value for K_1, the inside wall surface, for various material was 1.34. The values for K_o, the outside wall surface, is generally taken to be 3 K_1, or 4.02. The average K_1 and K_o is equal to K, or 2.63. In the following calculation, the value for the surface resistance has been taken as $K = 2$.

Due to the difficulty experienced in maintaining a perfect dead air space in cars, some engineers entirely ignore the air spaces in their calculations, but this practice does not seem to give true results where a number of narrow air spaces are provided. It is, therefore, considered fair in making a comparison of the insulation values for different types of cars to assign a value to each air space. Each air space will be considered as having two exposed surfaces and for convenience given the same value.

The conduction of heat or the thermal conductivity of various substances have been rather definitely ascertained by a number of tests. These are published by the National Bureau of Standards.

Heat Requirements for Passenger Cars

The required heat to keep the interior of the car comfortable depends upon the construction. One of the drawings is a cross section of a recently built car, and is a good example of a modern passenger car construction. It is necessary to point out that the design selected for analysis is better insulated than the average passenger car built. The length of car will be assumed to be 72 ft. inside.

The value for $\frac{x}{C}$ for thin steel plates and paper is so small that it will be neglected in the following calculations, in which the thermal conductivity of the materials has been

reduced to an hourly basis. The heat loss through the floor may be determined in the following manner:

$1\frac{1}{2}$ in. Salamander insulation: $C = 6.5; \frac{x}{C} = \frac{3 \times 24}{2 \times 6.5}$ 5.54

$1\frac{5}{8}$ in. wood floors: $C = 23; \frac{x}{C} = \frac{13 \times 24}{8 \times 23}$ 1.69

Two surfaces: $K = 2; \frac{2 \times 1}{K} =$ 1.00

Total 8.23

$H = \frac{1}{8.23} =$ .... 0.1215 B.t.u. per sq. ft. per hr.

For the entire floor the heat transmission per degree difference in temperature $= \frac{9.08 \times 72}{8.23} =$ .... 79.44 B.t.u. per hour

[Analyzing the various surfaces and calculating the heat losses in B. t. u. per hour, in the same way, using the proper values for *C* as given by the Bureau of Standards, the author arrives at the results shown in the following table.—Editor.]

Heat Loss Through Transmission Per Degree Difference in Temperature

	B.t.u. per hr.	Per cent
Floor	79.44	14.2
Side walls, below seat rest	12.79	2.3
Side walls, ends, posts	62.35	11.2
Windows, double	130.00	23.3
Letter board	53.75	9.6
Lower and upper decks	184.00	33.0
Upper deck, sides	22.66	4.1
End doors	13.13	2.3
Total	558.12	100.0

To make allowance for train speed and imperfect insulation surrounding steel parts such as posts and other details, 20 per cent will be added to the 558 B. t. u., shown in the table, making a total of 670 B. t. u. per hour. Approximately this amount of heat will be lost for each degree the outside temperature is lower than that in the car. This heat, together with what is required to heat the incoming air for ventilation and the heat lost through the train line underneath the car, must be supplied to the car. From this amount of heat, however, can be deducted the heat produced by the occupants in the car.

The average adult throws off about 400 B. t. u. each hour. At 70 deg. F., one B. t. u. will raise the temperature of 55 cu. ft. of air one degree. The proper air supply for each adult is generally assumed to be 1,000 cu. ft. of air per hour. The heat supplied from the human body will, therefore, raise the temperature of 1,000 cu. ft. air 22 deg. F. At a temperature of 50 deg. F., one B. t. u. will raise the temperature of 53 cu. ft. of air one degree, and the heat from an adult will raise a 1,000 cu. ft. air 21.2 deg. F.

The above shows that if 70 deg. F. is considered a comfortable inside temperature, no outside heat would be required to heat the air supply in the car until the temperature drops below 50 deg. F., provided a correct amount of incoming air is maintained.

We will assume that the outside temperature is 30 deg. F. below zero and the inside temperature in the car is maintained at 70 deg. F, which is equal to a temperature difference of 100 deg. F. It has already been shown that an occupant will raise the temperature of a constant air supply of 1,000 cu. ft. per hour about 20 deg. F. The air taken into the car must therefore be artificially heated 80 deg. F. The mean temperature of this air is at 10 deg. F. above zero. At this temperature one B. t. u. will raise the temperature of 48.5 cu. ft. of air one degree.

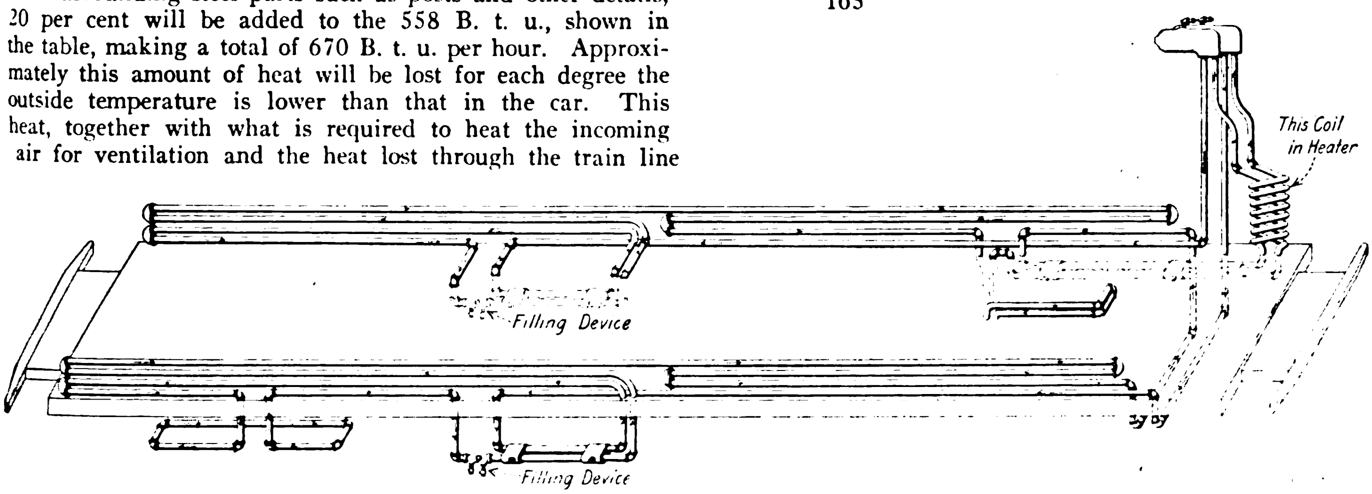
Assume that there are 50 passengers in the car, requiring 50,000 cu. ft. of air per hour. Then 82,500 B. t. u. per hour will be required to heat the incoming air. The heat required to keep the car at an inside temperature of 70 deg. F., against the heat losses will be $670 \times 100 = 67,000$ B. t. u. The average temperature of steam in train line is assumed to be 250 deg. F. and heat losses with a 75 per cent efficient pipe covering, 115 B. t. u. per lineal foot. The loss in the train line is $115 \times 100 = 11,500$ B. t. u. per car, or 0.34 boiler horsepower.

The total amount of heat for ventilation and heating is $82,500 + 67,000 = 149,500$ B. t. u. per hr. or 4.5 boiler horsepower, and the heat required per lineal foot of car is 2,076 B. t. u. per hr.

Radiation Surface and Fuel Required for Heating Cars

The usual size of pipes in a passenger car is $1\frac{1}{2}$ in. The heat transmission per foot of $1\frac{1}{2}$-in. pipe at a temperature of 212 deg. F. is about 165 B. t. u. per hour, at an inside temperature of 70 deg. F. The number of $1\frac{1}{2}$-in. pipes required is

$$\frac{2076}{165} = 12.6 \text{ or } 6 \text{ pipes on each side.}$$



Piping Arrangement for a Hot Water Heating System

It would hardly be necessary to install this number of pipes in a passenger car, as in extremely cold weather the ventilator would be closed and the air supply reduced, producing the same condition as in dwellings in cold weather.

If the vapor system is used, which keeps the pipes at a temperature of 212 deg. F., the following amount of heat will be transmitted into the car.

$760 \times 165 = 125,500$ B.t.u. or 3.75 boiler horsepower at 70 deg. inside temperature.
$760 \times 183 = 139,000$ B.t.u. or 4.16 boiler horsepower at 60 deg. inside temperature.
$760 \times 200 = 152,000$ B.t.u. or 4.54 boiler horsepower at 50 deg. inside temperature.

This will provide sufficient heat to keep the car comfortable in a temperature of 30 deg. F. It shows, however, that the heating system will be taxed to its capacity if doors and ventilators are not closely watched.

It requires $.34 + 4.54 = 4.88$ boiler horsepower to heat a car in extreme cold weather. In an average steam locomotive it will require 4 lb. of coal to produce one boiler horsepower, or it will take $4 \times 4.88 = 20.0$ lb. of coal per hour

to heat the car, or 480 lb. per day, or 1.7 tons per week. This is based on a temperature of 30 deg. F. below zero.

Some time ago tests were made at a terminal to ascertain the amount of water condensed in the heating system under certain conditions. A 70-ft. steel passenger coach was used in the test with windows, doors, and ventilators closed and the car at rest. The inside temperature was maintained at 88 deg. F., the outside temperature was 20 deg. F. above zero and the steam consumed as measured from the condensation was 106.5 lb. per hour. One boiler horsepower is equal to the evaporation of 34.5 lb. per hour from a temperature of 212 deg. F. to steam at atmospheric pressure. Hence the car required 3.1 boiler horsepower.

This car was equipped with five 1½-in. pipes on each side having a total length of 750 ft. The theoretical heat losses per lineal foot of 1½-in. pipe is approximately 140 B. t. u. at the given temperature, which would give by calculation 3.14 boiler horsepower. This proves that the actual condensation taking place in a passenger car closely corresponds to the theoretical radiation from the pipes. It may be of interest to mention that most of the coach yards in the northern part of this continent were originally provided with boiler capacity to furnish steam at a rate of three boiler horsepower per hour for the maximum number of cars stored.

It is reasonably certain that in extremely cold weather the average passenger car now in service will consume about four boiler horsepower per hour. A train consisting of 12 cars will then consume 48 boiler horsepower per hr., or 1,656 lb. of steam per hr. The steam capacity of a modern Pacific type passenger locomotive of a maximum tractive effort of about 40,000 lb. is approximately 46,800 lb. per hour. The cars will, therefore, consume 3.6 per cent of this amount in extremely cold weather, but as the boiler will not work at 100 per cent efficiency in cold weather, the actual percentage will be considerably higher.

Suggestions Pertaining to Car Heating

1—Heat losses through windows constitute 23.3 per cent of the total. We pay dearly for windows in passenger cars, when cleaning, breaking of glass and loss of heat are taken into consideration. In sleeping cars and parlor cars, where each passenger has ample room and light, would it not further economy and safety to reduce the number of windows?

2—The area at letter board and lower and upper deck is not insulated in proportion to the balance of the car. The heat losses at these areas are 42.6 per cent of the total. Insulation can readily be improved at these points and considerable saving in fuel and increased comfort to passengers would result.

3—There is decided economy in using storm sash as the heat losses at windows are thereby reduced one-third.

4—It is a common practice to use 2-in. insulation in floors and walls and 2½-in. in ceiling of refrigerator cars, and it does not seem out of place, when the heat losses are seriously considered, to adopt this practice in passenger cars. The heat losses would thereby be reduced about one-half; the car would be cooler in summer and less noisy.

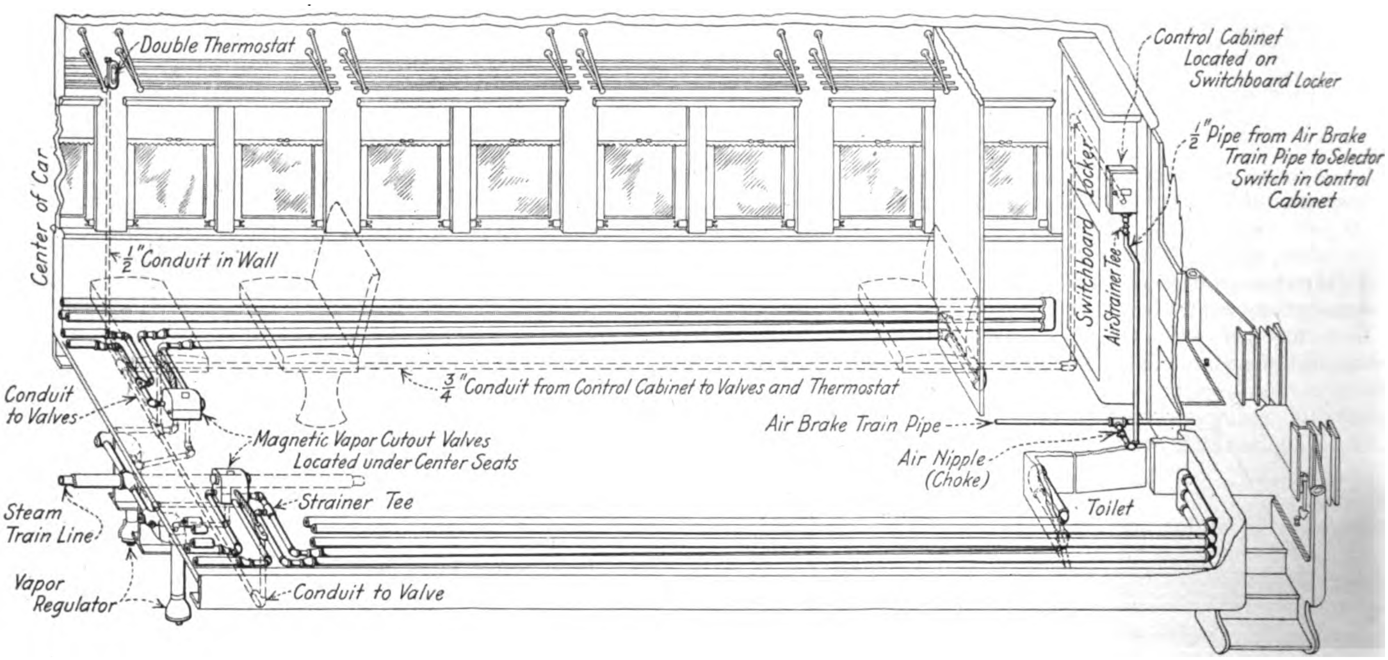
5—Insulation should be applied continuously the full length of the car in one piece in place of in a number of small pieces fitted between steel members. This could be accomplished by applying the insulation to the inside face of the steel members in the same manner as in steel frame refrigerator cars.

6—When passenger cars are in the coach yard for cleaning or storage it is not necessary to maintain a high temperature and the steam supply should be reduced. This can best and most economically be accomplished by automatic heat control.

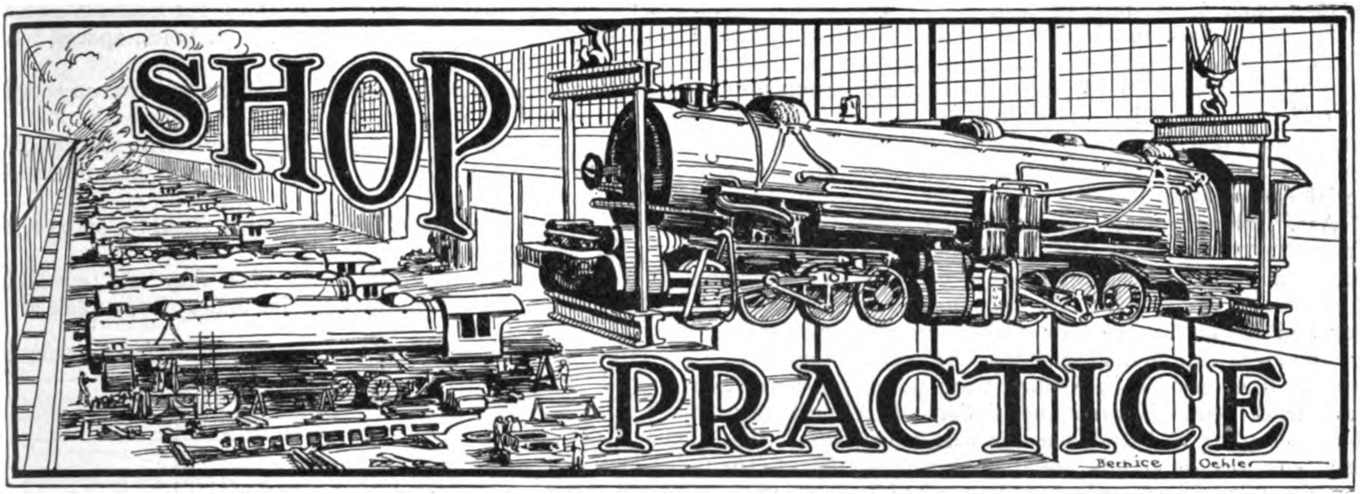
7—Heating pipes inside of the car should be installed with proper drainage and kept 2 in. from the floor, so the floor could be cleaned with a scrubbing brush or mop.

8—Steam pipes resting on the floor are subject to rapid corrosion and often have to be replaced, a considerable job as in most cases the seats have to be removed. Consideration should be given to the advisability of using iron or even brass piping for car heating, or having this piping protected by galvanizing or some other durable and non-corrosive coating. The disadvantage of galvanizing lies in the fact that it does not protect the threaded couplings which are the most vulnerable parts of this pipe system. A malleable lead plating would be preferable and less expensive than wrought or brass piping.

In the analysis of heating it has been shown that at the present time the average passenger car is not uniformly insulated when heat losses are considered. A close study of the problem will reveal that it is immaterial if the car is made of wood or of all steel, provided the proper amount of insulation is used.



Installation of a Vapor Type Heating System



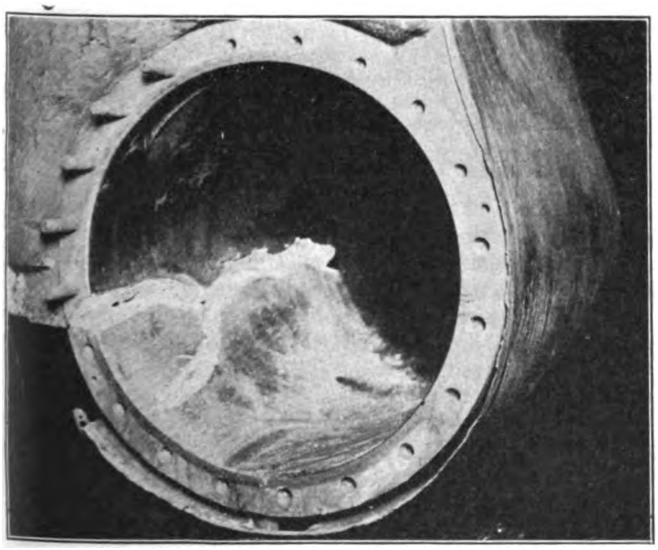
Welding Standardization in Locomotive Shops*

Methods Used on Running Gear, Cylinders and Reclamation Work—the Proper Care of Equipment

By James S. Heaton
Welding Supervisor, Wabash, Decatur, Ill.

THE importance of making the proper preparation for a weld cannot be over-emphasized. A failure on the part of the operator to observe instructions, such as were outlined in the first part of this article, will result in unsatisfactory welds. The sand blast usually makes a thorough job of cleaning and its extensive use is recommended.

In repairing mud-ring corners that have deteriorated, the



Engine Cylinder Before Welding

edges of the sheet should be cut so that the mud-ring will show at least 1/4 in. After this work is completed, the worn places should be cleaned with a sand blast. Weld along the mud-ring first, and then along the vertical seams, filling both seams to 45 deg.

When washout holes have been reamed beyond standard or have been worn away, countersink the hole and insert a bushing. Weld by filling the countersink and reinforce around the bushing. If the plate around the hole is deteriorated, insert a brass plug and weld around it. The plug can be removed very readily.

Patches may be welded on smokeboxes by either the butt weld or the lap weld method. Seams and edges of the butt straps should be welded, as this makes an air-tight job and a smokebox must be air tight.

Frames and Motion Work

There are many different parts that can be welded with safety and at less cost than they can be replaced or repaired by the old methods of patching and blacksmithing. However, care should be taken and experienced welders should be used on all operations. The building up and welding of spring equalizers, spring saddles, truck equalizers, spring seats, cylinder heads, tanks, oil drums, etc., can be readily accomplished if ordinary care is taken. Savings can also be effected in many other ways with welding.

In welding frames, see Fig. 2, approved procedure is to tram the frame and see that it checks with the opposite side, then tram over the break, locating points by which expansion will be governed, allowing 1/8 in. to 3/16 in. according to the size of the frame. Frames should be cut out with a double vee whenever possible, using the cutting torch to do the work. Clean the surface with a sand blast and apply a 3/8-in. plate for reinforcing on the bottom. This plate should extend 1/2 in. on each side of the frame to allow for the side reinforcing rods. Weld the plate solid to the frame, then when the frame is large enough, filler rods should be used. However, extreme care should be exercised to obtain a perfect union between the added metal and the filler rods. The use of the filler rods effects a very large saving in time and material. It has been proved that the quality of the weld is just as good as welds made without the rods, if proper care has been taken in doing the work. All frames should be reinforced on the sides and top by using 1/2-in. rods extending 1 in. on each side of the weld. Care must also be taken to weld solid between the rods. For this work

*This is the concluding installment of an article begun in last month's number, page 176.

3/16-in. and ¼-in. mild steel electrodes are recommended.

For worn places on frames, it is best to use boiler plate the desired thickness to bring the frame to the standard size. Allow ¼ in. on all sides of the plate and punch holes in each corner and in the center of the plate. Then clamp the plate in place and weld around it and fill the holes solid to the frame. By welding solid considerable time and material is saved.

As a rule, the fractures encountered in cast steel truck frames are located in the tension members. In order to secure a proper factor of safety at the joint, a reinforcing plate should be applied to the underside of the tension member and the fractured edges beveled and then welded from the opposite side and around the reinforcing plate.

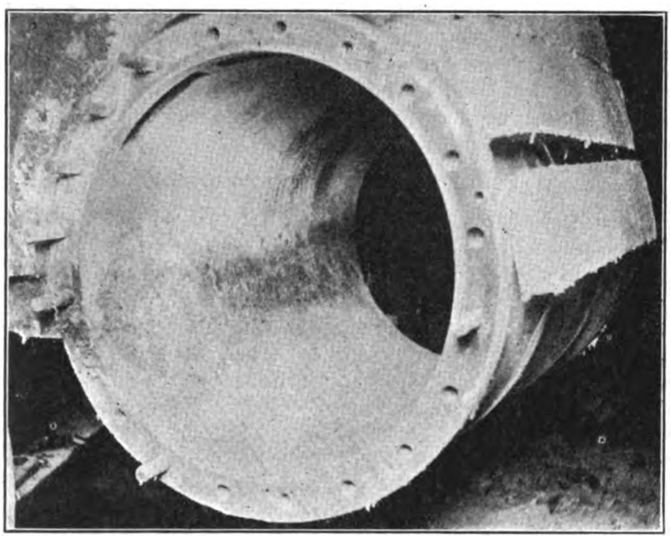
It is recommended in welding worn places on engine and tank truck pedestals, arms and binders that electric be used for steel parts and acetylene for cast iron parts. A mild steel electrode should be used when welding by electricity and cast iron rods should be used when welding by acetylene.

Holes in guide yokes, frame and bumper beams should be fitted with plugs, allowing ¼ in. on each end for welding. This makes a solid weld and eliminates a waste of time and material by having to weld the hole.

Cracks in deck castings and cross-ties should be beveled with a cutting torch to 45 deg. and cleaned off with the sand blast. Then place a screw jack between the frame to relieve the tension and weld by the electric method. Take out the jack when the weld is half finished.

When holes are worn or broken out in brake hangers, beams and binders, insert a carbon stick in the hole and weld around the stick. This eliminates the drilling out of a completely filled hole.

Worn places on the front end of main rods should be welded by the electric method. In reducing the size of the



Engine Cylinder After Welding

opening for the front brass, or welding on an oil cup the electric method should be also used.

When knuckle pin holes in side rods are to be reduced, use a round rod of the size required to reduce the hole. Shape it into a ring and insert it in the hole and weld by the electric method, taking care to weld solid at the bottom and make the rings square at the top. This method also reduces the amount of time and material as compared to that required in welding solid. This method should also be used for wrist pin holes.

When a connection hole is to be reduced, use bar iron of the size required to reduce the hole. Shape it into a ring, as in the previous job; insert it in the hole and weld by the electric process. The ring should be placed so that an opening ½ in. will be left on each side of it for welding. When the iron is 3 in. or more in width, 1-in. holes, spaced 3 in. apart, must be punched in the center.

When such parts as piston rods and shafts are worn beyond a fit, they can be built to standard by using the electric method, with a mild steel electrode. This will machine the same as the original metal and good threads can be turned from this welding.

All wearing parts of the link motion should also be built up by the electric method.

When guides are ⅛ in. under size, they can be welded solid. If they are more than ⅛ in. under size, a plate with

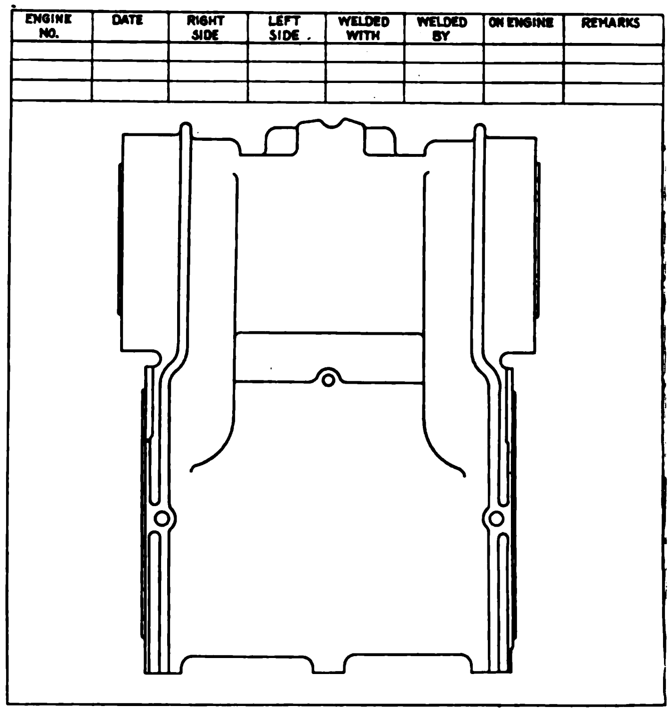


Fig. 3—Report That Is Used for Showing the Location of Welding Work Performed on the Side of a Cylinder

holes drilled in it 6 in. apart, should be clamped to the guide and the edges and holes welded solid. The electric method should also be used for this job.

Piston Heads, Crossheads and Valve Bushings

When piston heads are worn at the bottom side, they can be built up with Tobin bronze, applied by the acetylene process. It has been found that heads built up by this method wear better than the original metal.

When a crosshead is worn by the front end of the main rod, it should be welded solid. If the gib holes are worn they should also be welded solid. The electric method is recommended for this character of work.

Valve and cylinder bushings can be removed very easily with the carbon arc. The old method of chipping out with a hammer and chisel is a long and tiresome job.

Repairing Cracked Cylinders

In cylinder work, see Figs. 3 and 4, have the crack chipped out to 90 deg., leaving an opening at the bottom of ⅛ in. Have the cylinder lagged, except at the break and then place a charcoal pan under the cylinder and fill it with charcoal until it reaches well up on the sides of the cylinder. Heat to cherry red color and weld by using cast iron rods with a flux. If the break is very large, it is best to have two welders on the job so that the work can be finished after once starting. When the work is completed cover the cylinder completely with lagging and asbestos sheets and allow it to cool gradually over night.

If the cylinder has a thick wall and happens to be broken on the side, have the crack chipped out from the outside and apply studs staggered about two inches apart and weld by the electric method, first welding around the studs and then between them. Use mild steel electrodes and cast iron flux. By this method the cylinder does not have to be heated or bored.

Stoker Repair Work

For stoker conveyor and elevator screws, use round iron the desired thickness to bring the flukes to standard. Form the rod around the flukes and tack the weld at intervals of 8 in. Continue this method until the rod is formed over the worn place and then weld on each side of the rod, extending

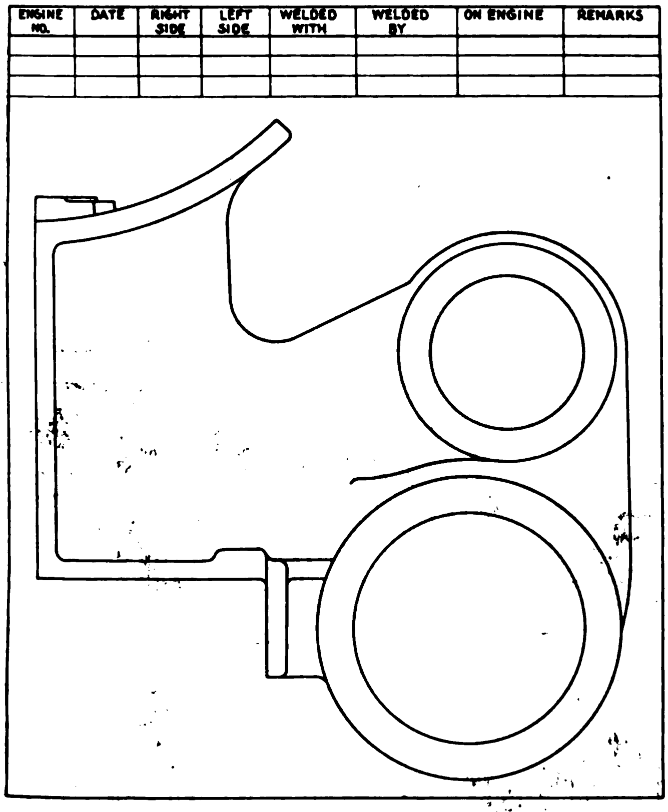


Fig. 4—Form to Report Welding Work Performed on the End of a Cylinder

down on the fluke one inch. Weld by the electric method and use a carbon steel electrode. Worn places on the drive shaft, elevator shaft and pawls can also be reclaimed by electric welding the worn places, using a mild steel electrode. Breaks in the elevator screw housing can be repaired by brazing by the acetylene process, using Tobin bronze with a brass flux.

Superheater Units

Cast steel or torpedo superheater unit ends must be cleaned off completely until good metal shows. Preheat to an orange red and slightly carbonize the flame while working inward. Use a little cast iron flux and allow to cool slowly. It is best to use Swedish iron for this work and be sure that all the water is removed before starting to weld. This procedure must also be followed when welding by the electric method, except the mild steel electrode should be used.

Rod Brasses and Driving Boxes

When welding rod brasses, preheat in the furnace until they become a very dark brown color, then remove and weld by using Tobin bronze and a brass flux. When finished, allow them to cool in the open air. When more than one brass is to be welded, place another brass in the furnace as soon as one is taken out. This will save time.

The following method should be used in reclaiming cast iron driving boxes. When cellar bolt holes are worn or the lugs are broken at the holes, preheat the cellar in the furnace to a dark red color. Prepare the necessary number of carbon cores of the required size, leaving the core long enough to prevent any metal from distorting the shape of the hole on the outside surface of the lug. Then place the core rod and puddle the metal around it from the top of the hole. Be sure to penetrate about half way through and build up even with the face of the lug, then turn the casting over and complete the work on the lug first started. Finish one at a time. After welding, allow the box to cool slowly. This method eliminates the boring out of solid material. If the lug is broken off, then weld solid. Use cast iron welding rods for both operations.

In welding shoes, wedges and hub liners on boxes, the liners should be beveled to 45 deg. on the edges and made ½ in. smaller all around. Holes should be punched or drilled in the center of the liners. Weld by first filling the holes and then around the edges of the liners. This eliminates the drilling and tapping for patch bolts. Care must be taken to weld solid through the holes to the box.

Broken Wheel Spokes and Tires

For broken wheel spokes, cut the rim next to the broken spoke. Bevel one end of the spoke at the back to 45 deg. on both sides and clean by using the sand blast. Then jack the rim out ⅛ in. and weld by the electric process. Weld

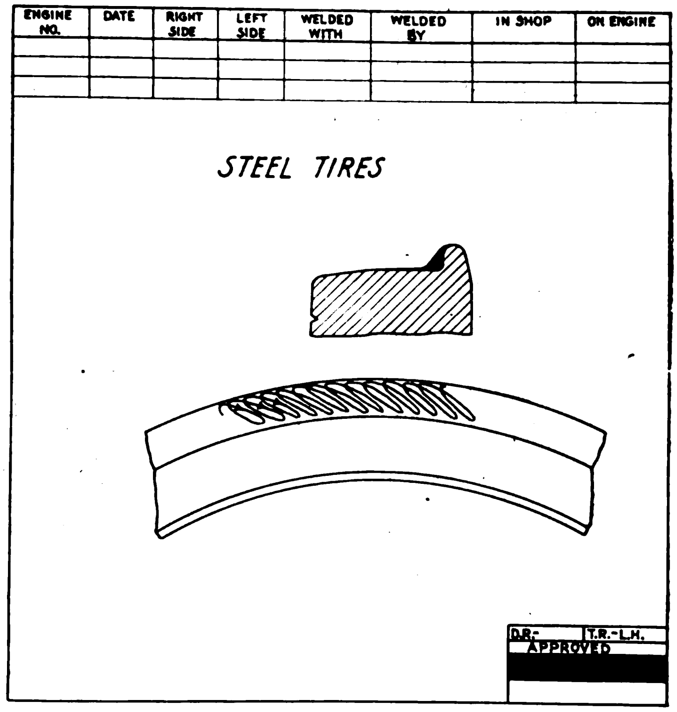


Fig. 5—Form for Reporting Welding Work on Steel Tires

one side, then remove the jack and finish the weld on the other side. The object in cutting the rim is to take care of any stresses that might be set up and eliminate the possibility of wearing a flat spot over the welded spoke.

Start welding tires on the front or back quarter and weld two feet, operating the arc back and forth across the flange. Then turn the wheel two feet and proceed in a like manner until the job is finished. The main object of this method is to keep the arc moving, thus preventing the flange from heating to any appreciable depth. If the tires are to be turned after welding, use a low amperage, if not, then use a

high amperage. A report, as shown in Fig. 5, should be made of all tire work.

Reclamation Work

For reclaiming axles, the standard sizes and limiting dimensions of A.R.A. axles for passenger, freight and tender trucks should be followed. Axles condemned for lateral wear occurring at the collar and shoulder of the journal can, in most cases, be returned to service if only the collar is built up and turned to standard dimensions. This can be done without heating or annealing.

The reclamation of couplers includes not only minor repairs, such as building up worn shanks, but also the welding of heads. All fractures should be cut out the full depth of the thickness of piece, cleaned off and welded, and have extra reinforcing wherever possible. A worn coupler should have a piece of boiler plate applied and then welded around it. Worn knuckles should be built up on all wearing points. A 6½-in. coupler butt may be converted into the new 9⅛ in. standard by welding on boiler plate shims to increase the dimensions.

Another item on which considerable savings have been effected is in the building up of chaffing irons and angle bars by electric welding. In the old days when they had become worn they found their way to the scrap pile.

Fractures in car bolsters should be cut out and prepared for welding in the same manner as explained for couplers. In addition, a reinforcing plate should be applied. When fractured bolsters are received that have previously been repaired by riveting on straps, the straps and rivets are removed and the fracture is welded. The rivet holes are then welded up and a reinforcing plate is welded on. This is extended over the zone within which the particular class of bolster has indicated a weakness.

In all of the jobs just outlined where the kind of electrode to be used has not been specified, a mild steel electrode should be used.

Acetylene Welding

Before starting to weld or cut, be sure that the regulators are in proper condition. Turn the screws to the right until the right pressure shows on the small gage. The large gage registers the amount of pressure in the drum and the small gage registers the pressure in the hose.

If any trouble is encountered with the equipment, the operator should not try to repair it himself, but should take it to the foreman or to the toolroom. The equipment is of a delicate nature and requires skill to repair it. Do not connect a hose to a drum without a gage. It is dangerous as the hose may burst and result in injury to the operator. Have only the pressure required on the small gages so that the pressure will not have to be controlled by the valve on the torch.

Do not start a weld that has not been cleaned properly and all possible allowance made for contraction. Do not cut plates that can be sheared and never use a tip that is too large. This will save gas and will make a neater job. When practicable, the gasoline or oil torch should be used for heating large surfaces. It is too expensive to use the welding torch for such jobs.

Torches

Care must be used in lighting and shutting off the torch. To light a torch, the acetylene must be turned on first and the gas ignited. Then open the oxygen valve and add oxygen until a bluish flame with a small bulb appears. This is a neutral flame and must be used at all times except when welding cast steel ends on superheater units. When a carbonizing flame is to be used, it can be obtained by using excess acetylene.

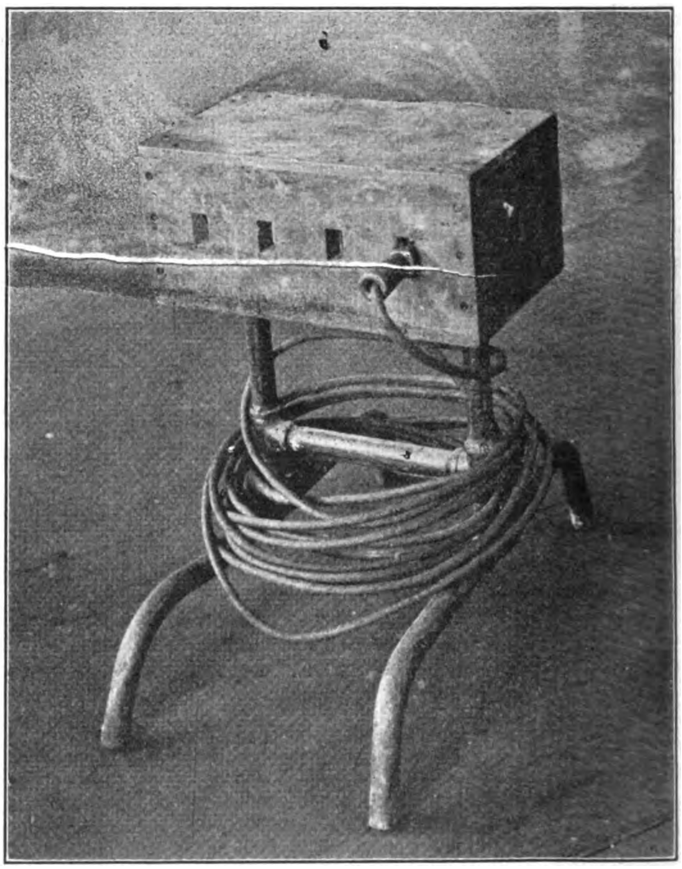
When the operation has been completed, the acetylene valve must be shut off first and then the oxygen valve. If the oxygen valve is closed first and the acetylene valve is leaking, the flame may cause a back-flash in the hose. Never shut off the oxygen valve first except in case of a back fire.

If a tip comes in contact with the molten metal, the holes will become clogged, thereby causing a torch to back fire. Loose heads and joints will also cause back fires in the welding torch. When a cutting torch back fires, the oxygen valve must be shut off first and then the acetylene valve. Then put the tip and the head of the torch in water to cool off. When a welding torch back fires, the oxygen valve must be shut off first and then the acetylene valve, then put the tip *only* in water until it is cooled, when the head may be immersed. When a cutting torch is leaking at the head from overheating, never tighten the tip nut until the head and tip have been cooled off completely, for by so doing the threads on the head will be stripped and the torch will be ruined.

Multiple Extension Outlet

THE multiple extension outlet shown in the illustration is particularly suited for use in locomotive erecting shops. A number of them are in use in the Union Pacific shops.

The device consists simply of a rectangular wooden box mounted on a standard or frame made of 1-inch pipe. There are ten small rectangular holes cut in the box, four on each side and one on each end, and behind each hole is placed a special receptacle. All of the ten receptacles are connected in multiple. A piece of two-conductor reinforced cord with a plug at either end completes the outfit.



Multiple Extension Outlet Which Will Serve Nine Portable Extensions

At times there are six or eight men at work on a locomotive, each of whom wants to use a portable extension light. It is not practicable to have that many extension outlets at each locomotive location and where all of the outlets are at an end of the locomotive on a column or post it is necessary to have long extension cords.

Well Equipped Engine Terminal on the R. F. & P.

Plant Includes a 30-Stall Roundhouse, a Large Machine Shop and Complete Outside Facilities

A THIRTY-STALL roundhouse, with complete outside and inside facilities and an unusually well equipped machine shop, was completed and placed in operation in January, 1924, by the Richmond, Fredericksburg & Potomac at Richmond, Va. This terminal is especially notable for the extent to which the requirements of future increases in the volume of business were incorporated in the present construction as well as in the provisions for later extensions.

The new facilities, which replace the old Boulton terminal located within the city limits, are located outside of the city of Richmond, adjoining the Acca freight yard. This yard is the freight interchange point between the R. F. & P. and the Atlantic Coast Line and the engine terminal cares for the Atlantic Coast Line power as well as that of the R. F. & P. This includes both freight and passenger locomotives.

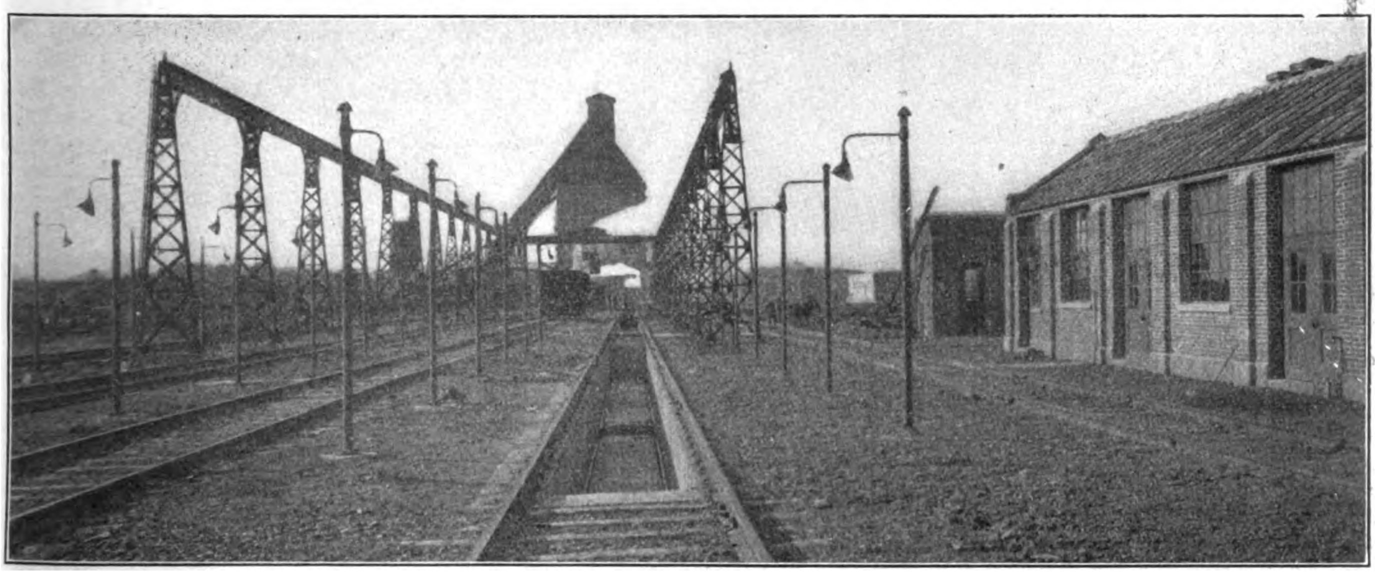
Outside Facilities

The general layout of the terminal tract is shown in one of the drawings. It lies at the south end of the freight yard and future expansion will extend toward the north. The inbound and outbound tracks, which lead from the south end of the yard, are operated left-hand. These leads are kept well separated where they approach the main and lead tracks at Acca tower and several cross-overs have been installed in order to prevent any possible blocking of the terminal by derailments or other accidents. An additional outlet is being provided over a lead skirting the freight yard and making connection at its north end. A second track on this lead will care for the wreck train equipment. This arrangement obviates practically all possibilities of bottling up the terminal. The inbound lead serves four inbound tracks, two of which pass over the inspection pits and inbound ash pits. One track forms a direct lead to the enginehouse and the fourth, actually the third on the layout, is for the use of switch engines and for loading ashes. This track ends at the sand storage bin and sandhouse, and on it sand cars are unloaded by the ash pit crane. The other tracks pass under a 1,000-ton Roberts & Schaeffer concrete coaling plant and thence to a Bethlehem 105-ft. twin span turntable. The outbound tracks have two grouped and one separate lead from the turntable, the two track portion branching into a number of engine storage tracks. The main stem of the outbound tracks passes along the coaling plant and outside of the ash pit crane runway over a small outbound ash pit of unique design.

The inspection pits are of concrete construction, 100 ft. long by 3 ft. 6 in. deep. Located centrally is a concrete lined tunnel which connects both pits and the inspector's office. It is reached by a stairway from each pit and a stairway located inside the building. Excellent lighting has been obtained by rows of six 150-watt angle reflectors on each side, set 7 ft. from the center of the track and 9 ft. 6 in. above the base of the rail so that they distribute the light over the running gear of the locomotives. Pit lighting has been obtained by gas-proof fixtures set in recesses in each pit sidewall; the recesses are painted white to secure the maximum reflection.

On the north side of the tracks, parallel to the inspection pits, is a brick tool and inspectors' house 82 ft. long by 16 ft. 9 in. wide. At the incoming end of the building is a locomotive tool storeroom 40 ft. long, in which are stored the shovels, oil cans and enginemen's tool boxes removed from the locomotives as they arrive at the pit. Adjoining the storeroom is a room 22 ft. long, now devoted to electric headlight equipment inspection and repairs. Eventually this room will also be used for such facilities as may be required for the inspection and testing of automatic train control engine equipment. The inspection pit tracks will be sectionalized to permit complete testing of the apparatus while the locomotive is over the pit.

In the west end of the building is the locomotive inspector's office, 20 ft. long. Here the enginemen make out their work reports on the first sheet of a double sheet form, turning it in to the inspector, who enters his inspection report on the second sheet of the form and then despatches the form, through a pneumatic tube carrier system, to the assistant foreman's office in the roundhouse machine shop. While the locomotive is passing over the ash pit and being coaled, the foreman has time to assign it to the most convenient stall for the work required and to have preparations made for the work, if the

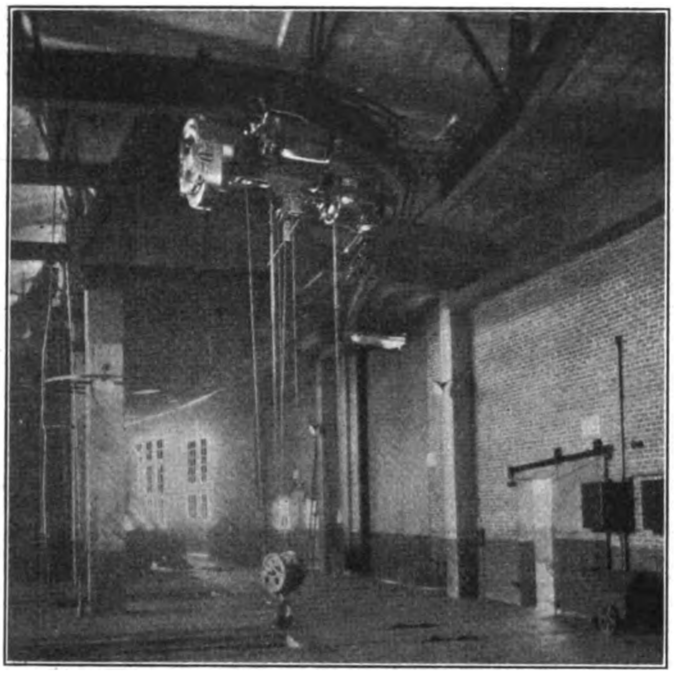


The Incoming Engine Facilities—the Inspection Pit in the Foreground, with the Locomotive Tool and Inspectors' House at the Right

available terminal time is short, before the locomotive arrives at the turntable.

The two main ash pits are 250 ft. long, 3 ft. 11 in. wide and 4 ft. deep, lined with vitrified paving brick, and are of the wet type. These pits are served by a 5-ton overhead crane and a 2-yd. grab bucket, the runway for which is 375 ft. long with a 50-ft. span supported by steel columns. The ash loading track also contains a short pit 100 ft. in length, which is used primarily for cleaning the fires of switch engines working in the Acca yard. This greatly facilitates the serving of the local switching power between tricks without disturbing the regular operation of the terminal.

The outbound ash pit consists of a shallow, dry pit, 12 ft. long, located under the outbound track and interconnected with a wet pit of similar size, but of greater depth, under the



One of the Six-Ton Pawling & Harnischfeger Electric Travelling Hoists

adjoining ash pit track, where crane service is available. This connection is sloped downward between the tracks and as the ashes are dumped, they are washed down this slope by water delivered through four flat nozzles set in the side wall slightly above the brick bottom of the pit.

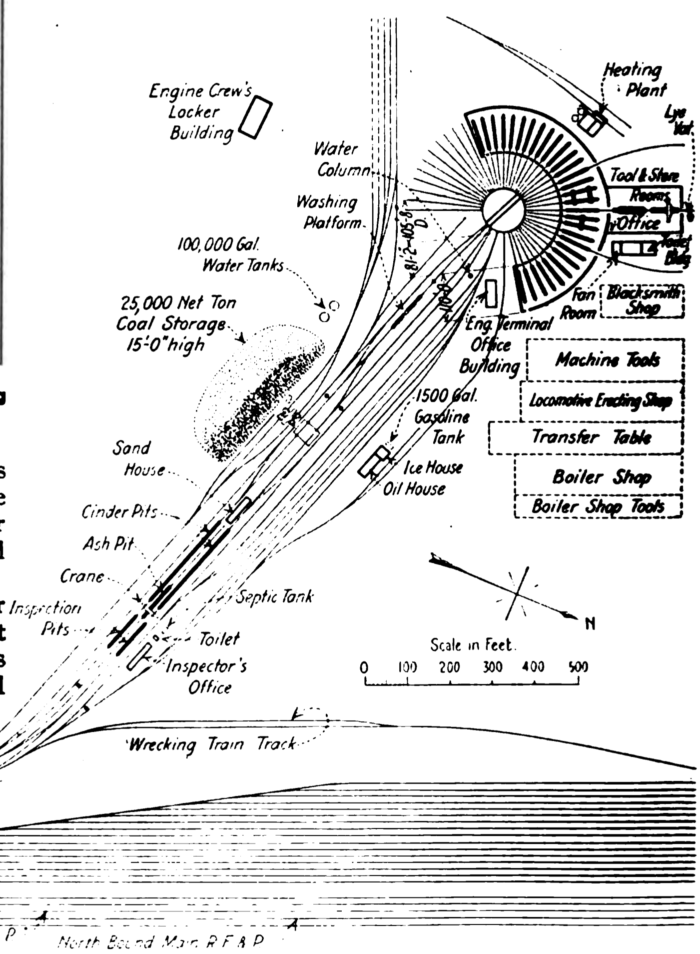
The coaling plant has a capacity of 1,000 tons, serves four tracks at one time with individual weighing bins and Strait scales, and is equipped with dual hoisting facilities. It is arranged with two unloading tracks passing over hoppers and terminating in coal storage tracks, which feed by gravity to the plant. It is also arranged with a coal storage layout utilizing the Beaumont cable drag scraper system of handling the coal. With the area now used for storage, the capacity is about 25,000 tons of coal with an average depth of about 15 ft., which is approximately two months' supply for the terminal. This system has greatly reduced the number of cars formerly held for coal storage and has otherwise facilitated the coaling operations of the terminal.

A reinforced concrete washing platform has been placed between the coaling plant and the turntable on one of the inbound leads. Several crossovers secure the necessary flexibility of operation to and from this platform. It is 100 ft. long by 20 ft. wide and is fully equipped with pipe connections for air, steam, water and sewerage.

The Enginehouse

The enginehouse is a 30-stall structure of concrete and brick construction with provision for the addition of 16 stalls when the necessity arises. The angle between tracks is equivalent to 56 divisions of a circle. The stalls are 110 ft. deep, with concrete engine pits 84 ft. long, inside dimensions. The clear door opening is 14 ft. wide by 17 ft. high. The structure is of the monitor type with five bays.

Stalls 11 and 12 are served by two National-Bingham drop tables to handle drivers, and stalls 14 and 15 by pit jacks of the hydraulic type to handle trailer and truck wheels. In these sections the columns were eliminated in order to secure a clear opening between Nos. 11 and 12 and Nos. 14 and 15, for the installation of a 15-in. I-beam upon which 6-ton Pawling & Harnischfeger electric hoists are operated. This installation circles the entire building approximately 10 ft. from the rear or outer circle wall, with switch leads to the drop pits and to the door opening on the material platform alongside the machine shop. Two of these hoists are provided.

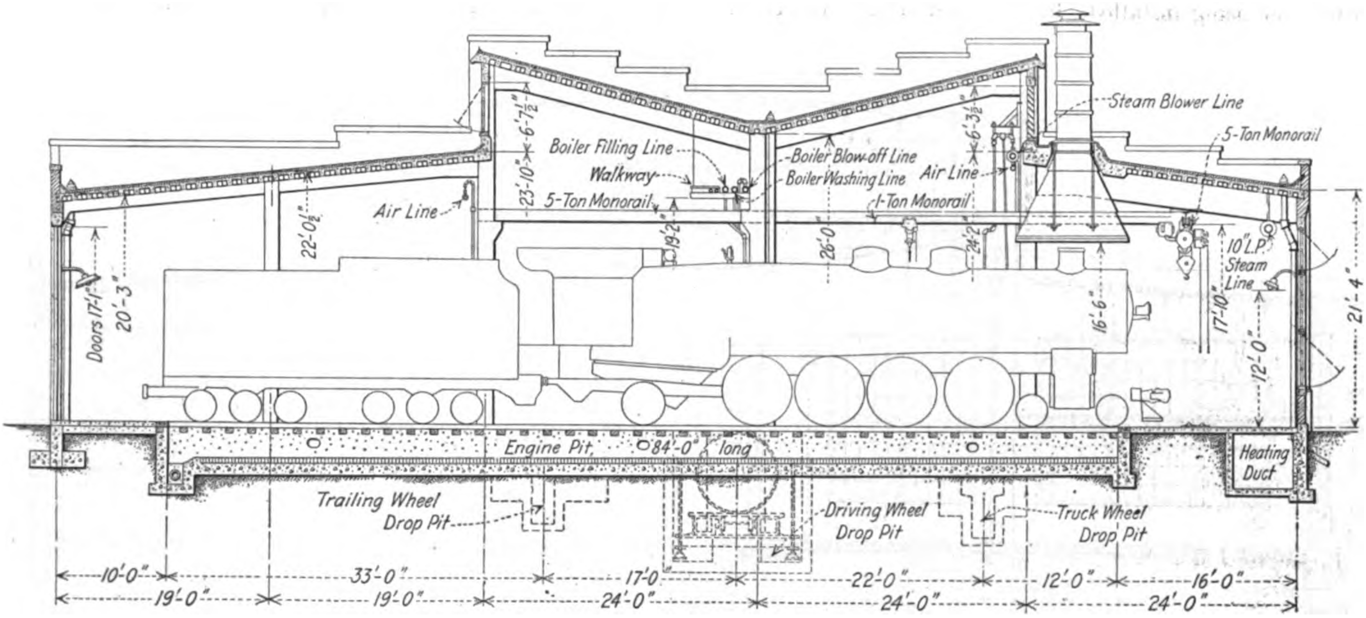


General Layout of the New Acca Engine Terminal—Proposed Location of Back Shop is Shown in Broken Lines

Each engine pit is served by two Cyclone ball-bearing chain hoists of one-ton capacity, operated on 10-in. I-beams set 10 ft. 6 in. center to center and extending over the outer

three bays within 1 ft. 6 in. of the center line of the 6-ton monorail.

A National boiler washing plant with 18 ft. diameter by

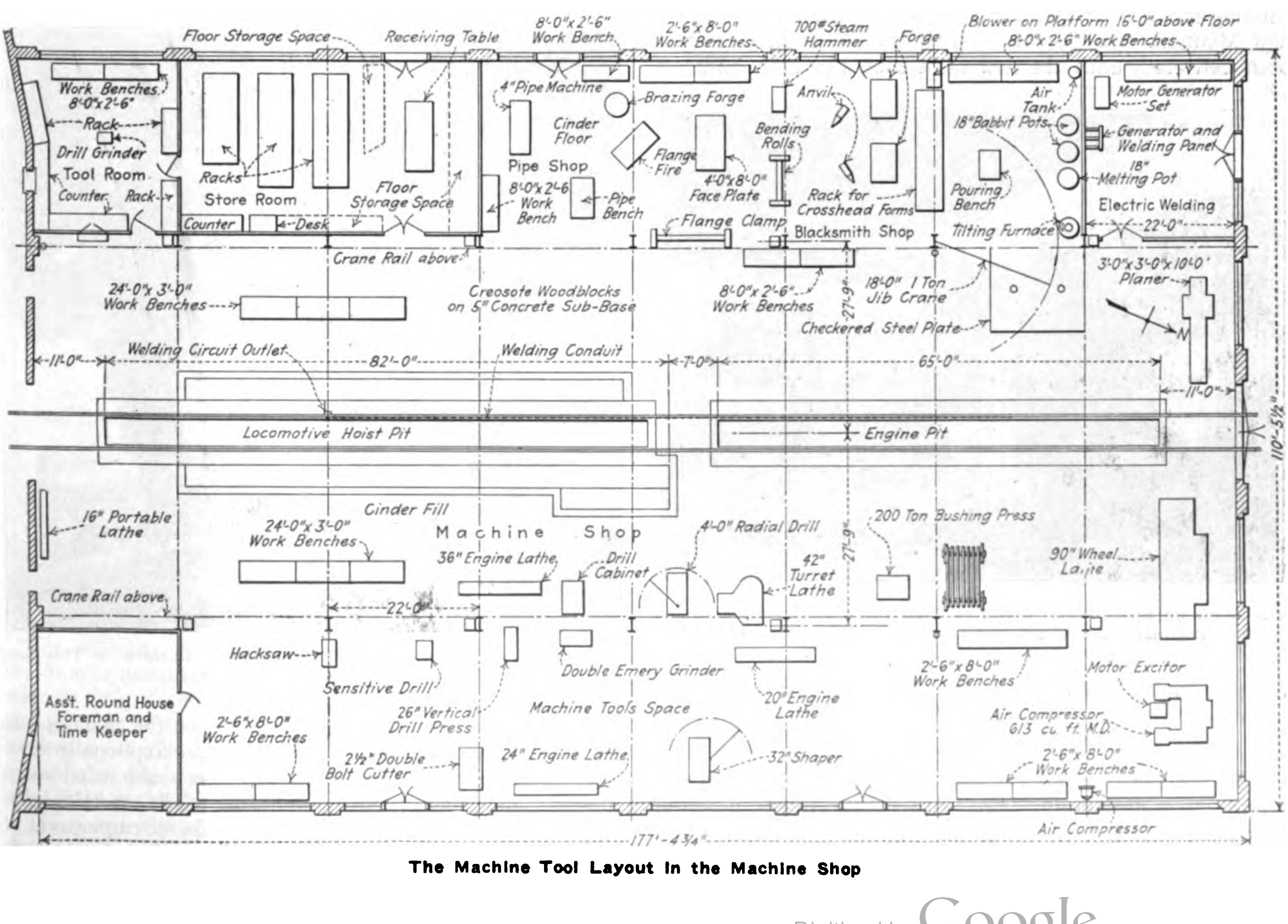


A Cross-Section of the Enginehouse Showing the General Arrangement of the Facilities

16 ft. high, wood tanks, serves one-half of the house, including stalls 16 to 30. The piping has been well arranged. One of the noteworthy features of this work is the suspension of a walkway alongside the boiler washing service pipes, following the column line under the center of the monitor. Another interesting phase of the piping is the blower drops. These drops are made from American bronze, encased, flexible hose with a Barco joint at each end, to relieve the hose of twisting strains, connecting with a Jenkins Selclo valve controlled from the floor by extension handles. Guard rails encircling the posts prevent the hose from becoming entangled with the lighting fixtures.

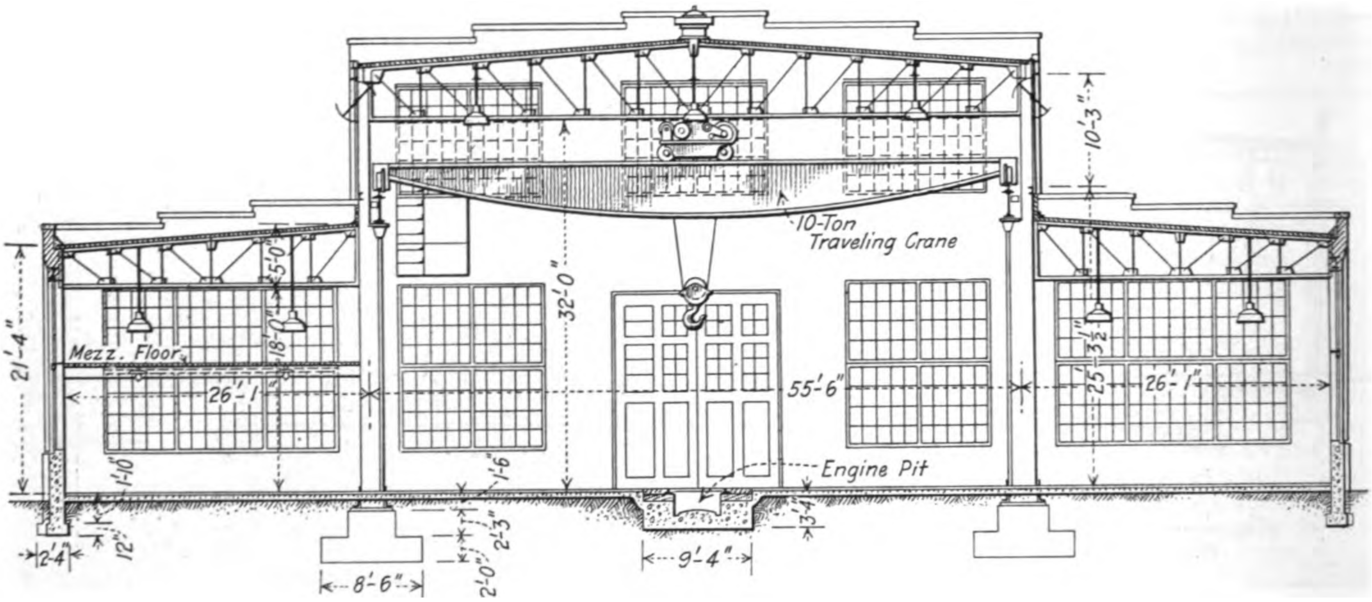
The Machine Shop

The machine shop is connected to the enginehouse opposite stalls Nos. 11 to 15. The drawings show the construction and dimensions. A wood block floor, laid on concrete, is

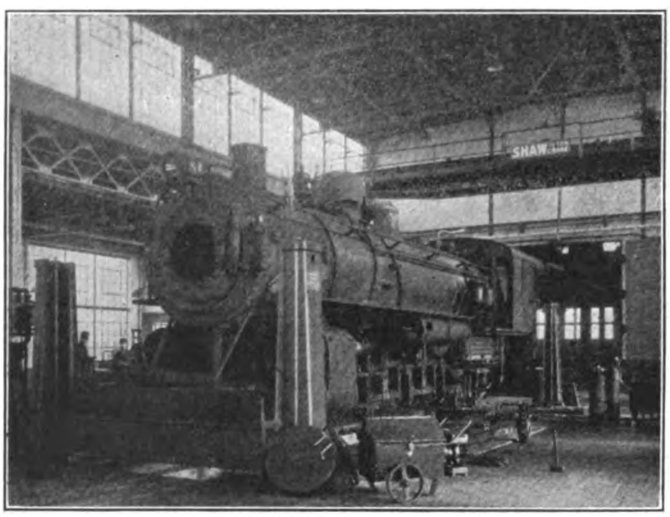


The Machine Tool Layout in the Machine Shop

provided, except in the section allotted to blacksmith work where cinders are used. The tool layout is also shown in one of the drawings. Most of these tools are new, a few only having been moved from the old terminal. In addition to the layout now being installed, the shop ultimately will be provided with an old 90-in. wheel lathe, a 3-ft. by 3-ft. by 10-ft. planer and a crank shaper, transferred from the old Boulton back shop, when the proposed new shop, shown in outline in the terminal layout, has been built and equipped. With the 100-ton Whiting hoist on the shop track, the engine terminal is now practically independent of the back shop for all heavy running repairs. It will also be used for heavy repairs to the new Mountain type locomotives, two of which have recently been delivered, until the new back shop has been built, as the pits in the old shop are too short to take in the new engines.



A Cross-Section of the Machine Shop, Looking Toward the Outer End

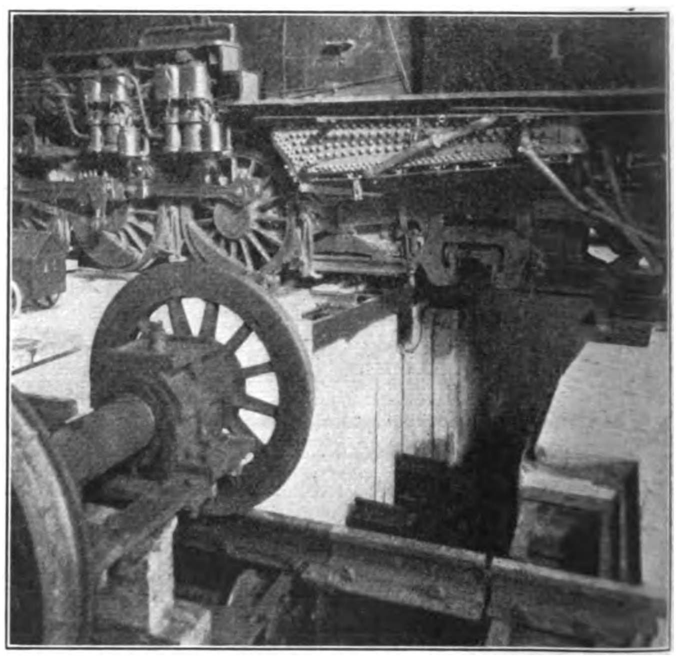


The Machine Shop Track Contains Two Pits; That Adjoining the Enginehouse Is Equipped with a Whiting Hoist

Heating and Lighting

The enginehouse and machine shop are heated by an indirect system discharging from two separate American blower installations into a concrete duct around the outer wall of the enginehouse and down through the machine shop. Six outlets are provided in each engine pit and there are additional outlets along the outer circle wall.

The enginehouse is effectively lighted artificially by means of Maxolite dome reflectors, using 100-watt lamps. There are nine of these reflectors for each stall, located 12 ft. from the floor and at an angle of 15 deg. From the inner circle, they are installed on a 1-1-2-2-2-1 arrangement, the single installations facing down the column line and the double installations facing to the sides, thus giving both longitudinal and side flood lighting at the rate of 900 watts per stall. All wiring is in conduit embedded in the concrete and plug receptacles are provided in the pits and on the columns. In the machine shop, the natural lighting is exceptionally effective because of the large expanse of steel sash windows in the sides and outer end of the building. The artificial lighting is also effectively cared for by the liberal employment of dome reflectors. Longitudinally, the column spacing is 19 ft.



The Drop Tables Are Installed for Handling Drivers; in This Case a Trailer Has Been Dropped

4 in. and for each section there are four Maxolite 200-watt lights in each side bay, and three 500-watt lights in the central bay.

Oil House, Crews' Quarters, Etc.

Other buildings include a small combined power, heating and boiler washing plant; a combined heating plant and shop employees' locker and toilet facilities; an oil storage and ice house; a terminal office building; an inspector's office building and an engine crews' rest and locker building.

The oil and ice house is located at the north side of the

11-15-23 20M Form MP-38

RICHMOND, FREDERICKSBURG & POTOMAC RAILROAD COMPANY

ACCA LOCOMOTIVE TERMINAL

ENGINEMAN'S WORK REPORT

INSTRUCTIONS—Each Locomotive and Tender must be inspected after each trip or day's work, and report made on this Form, whether needing repairs or not. Proper explanation must be made herein for failure to repair any defects reported, and the Form approved by Foreman before the Locomotive is returned to service. Verbal reports or reports not signed by Engineman are not acceptable.

Locomotive Initial______ Locomotive Number______

Date______ Train Number______ Arrived at Pit______M

NOTE—START EACH ITEM ON SEPARATE LINE.

	Repairs Needed	Repairs Made By
Machinery		
Stoker		
Boiler		
Ash Pan		
Cab and Boiler Fittings		
Air Brake and Piping		
Electrical Equipment		
Tender and Other Work		

Condition of Water Column and Glasses______ Gauge Cocks______

Condition of Injectors R______ L______ Brakes______

Safety Valve Lifts at______Pounds. Seats at______Pounds.

Main Reservoir Pressure______Pounds. Brake Pipe Pressure______Pounds.

Is Engine Blowing?______ Does Engine Drop or Throw Fire?______

How is Engine Steaming?______

Name of Fireman______Engineman's Signature______

The above Work has been performed, except as noted, and the Report is approved:

______ Foreman

The Engineman's Work Report Is the First Sheet of the Combined Work and Inspection Report

engine storage tracks, across from the coaling station. This is a one-story building, with basement, and is 90 ft. long by 30 ft. wide. The ice house, which occupies the west end of the building, is insulated with cork inside of brick walls, and has a capacity for 1½ cars of ice. This is ordinarily about one month's supply for the Richmond terminal.

In the basement of the building are located five tanks of 5,000 gal. capacity, one tank of 2,000 gal. capacity and two tanks of 1,000 gal. capacity. There are also seven 600-gal. and two 300-gal. tanks. The six larger tanks are provided with car filling connections and all the tanks are served by floor filling boxes.

The oil delivery room on the first floor contains 17 one-gallon Bowser measuring pumps, moved from the old terminal, and two tanks for the preparation of car journal packing. A storage room with a capacity for 1½ cars of waste, is also located on this floor. The building is fitted with steam fire extinguisher pipes, separately controlled for each floor, from outside the building.

The engine crews' rest and locker building is an attractive structure both from the outside and inside. It is built of brick and concrete surmounted by a gabled roof of red shingle tile. The second floor has a wide balcony extending around three sides and over a small portico on the fourth. This building contains a large reading and lounging room, locker rooms and toilet facilities on the first floor and dormitories on the second floor. Separate quarters are provided for the employees of the Richmond, Fredericksburg & Potomac, and those of the Atlantic Coast Line and the Norfolk & Western. A small part of both the first and second floors has been set aside for the use of the negro firemen of the A. C. L., completely detached from the remainder of the building. At one end of the second floor is a kitchen for the use of the men who wish to prepare hot food. It will be equipped with a gas stove, a modern sink and running water, a table and benches.

Operating Conditions

The Acca engine terminal turns from 80 to 100 or more locomotives a day during the busy season. Of this number, about 24 are switch engines and the remainder are divided about equally between freight and passenger service. R. F. & P. locomotives constitute about 80 per cent of the power

11-15-23 20M Form MP-38

INSPECTOR'S REPORT

NOTE—START EACH ITEM ON SEPARATE LINE.

Locomotive Initial______ Locomotive Number______

Date______ Inspection Completed______M.

	Repairs Needed	Repairs Made By
Machinery		
Stoker		
Boiler		
Ash Pan		
Cab and Boiler Fittings		
Air Brake and Piping		
Electrical Equipment		
Tender and Other Work		

Compressors and all other Air Equipment tested by me and is in good condition and in compliance with the Law

______ Air Inspector.

Headlight and all other Electrical Equipment tested by me and is in good condition

______ Electrical Inspector.

Gauge Cocks, Water Glasses (and Column, if used) blown out by me, all ports left open and connections tight and in good condition

______ Inspector.

Low water Alarm tested by me and is in good condition

______ Inspector.

Ash Pan examined by me and is in good condition

______ Inspector.

The above Work has been performed, except as noted, and the Report is approved.

Ready for Service______M. ______ Foreman

The Terminal Inspector Makes His Report on the Second Sheet of the Form

turned, the remainder being Atlantic Coast Line locomotives and the locomotives from two Norfolk & Western passenger runs between Norfolk and Richmond. With the exception of the engines operating in the Potomac Yard (Washington, D. C.), practically all of the 99 locomotives owned by the R. F. & P. depend on this terminal for running repairs.

Arrivals and departures are fairly well distributed throughout the 24 hours, with no marked peaks and no long periods of idleness. The heaviest periods are probably those between six and nine o'clock in the morning and five and eight o'clock

in the evening. During the former period, on the basis of a total daily movement of 80 engines through the terminal, 10 to 12 road engines and 9 yard engines are despatched, and 8 road engines arrive at the inspection pits. During the latter period, 12 road engines are despatched and 10 or more road engines arrive at the ash pit. The heavy afternoon switch engine movement takes place between four and five o'clock. The coal issued runs about 550 tons a day, or an average of about 7 tons per locomotive turned, including the switch engines.

It is evident that, with no future additions, the terminal is capable of effectively handling a much larger engine movement than it is now called upon to do, and that the outside facilities have ample capacity to balance the increased size of the roundhouse, when conditions require the building of the additional stalls. Something of the future for which this capacity has been provided, is indicated by the fact that the northbound perishable movement, which now constitutes, roughly, one-quarter of the total freight tonnage of the road, has been doubling approximately once in every five years.

The new terminal was developed and constructed under the direction of W. D. Duke, general manager; H. J. Warthen, superintendent motive power; L. Budwell, mechanical engineer, and E. M. Hastings, chief engineer. The plans were prepared and the construction carried out by the Arnold Company, Chicago.

Portable Oil Reservoir

By E. A. Miller

A PORTABLE oil reservoir that has proved its usefulness around railroad shops and terminals is shown in the drawing, Fig. 1. It consists essentially of a 14-in. by 33-in. reservoir for containing the oil, on top of which is mounted a separator through which the air is passed from an air line for the purpose of forcing the oil to the burners. This device is mounted on a truck carried on two standard 21-in. baggage truck wheels, bored and faced to fit a 1½-in. by 3-in. axle. Air is passed into the separator at the air inlet, as shown in Fig. 2, from an air line, from whence it is carried through the piping, as shown in the end view of Fig. 2 to the oil reservoir.

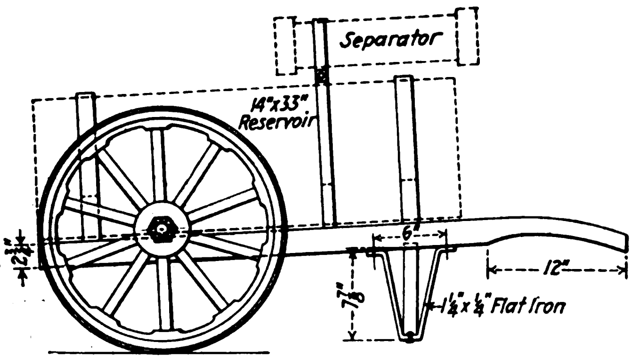


Fig. 1—Assembly Drawing of Reservoir and Truck

The air enters the oil reservoir at the top through a ¾-in. globe valve. This pressure on the oil causes it to be forced out through the 1½-in. wrought iron pipe which extends the entire length of the reservoir to within ½ in. of the extreme end. A ½-in. needle angle globe valve allows the oil to enter the burner through the burner connection. There is a ½-in. globe valve placed between the oil pipe and the air pipe, which can be adjusted for purposes of atomization.

Provision has been made in the piping arrangement for two burner connections. Either side can be operated separately by means of the two globe valves, which control the air from the separator and the oil from the reservoir.

This reservoir has been used successfully in providing oil for burners to thaw out ash pans, coal and sand pipes, as well as to operate car heating coils. When used for preheating for thermit welding, the burner connection is attached to a piece of ⅜-in. wrought iron pipe and is used without any burner. The apparatus is capable of handling various types of oil and can also be used for whitewashing. However, it is necessary to substitute a ½-in. angle globe valve for the ½-in. needle angle globe valve shown in Fig. 2.

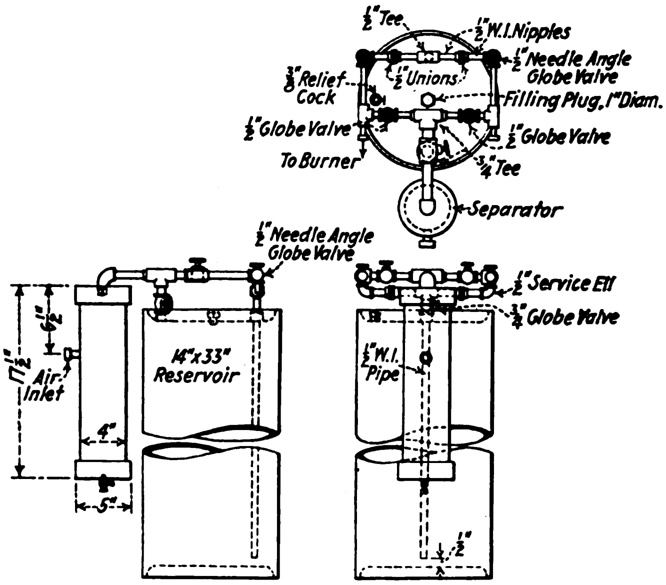


Fig. 2—General Arrangement of Reservoir and Piping

Convenient Facilities for the Air Brake Room

By F. G. Bonzheim

THE two devices illustrated in the drawings are simple to make from material which is likely to be available at any shop, and both are very useful in the air brake department.

The device shown in Fig. 1 is a power vise for holding freight car pistons while renewing the packing leathers or tightening the studs and nuts in the repair track air brake room. The pistons are removed from the car and delivered to the test rack with the non-pressure cylinder head and spring clamped to the piston sleeve. This assembly is very difficult to hold in an ordinary bench vise and can be handled with much greater facility in the device shown.

The complete device consists of a Shoemaker firedoor cylinder and two jaws, one moveable and the other adjustable, all of which are mounted on a steel bench plate. The moveable jaw, which slides on the plate, is operated by the air cylinder through the medium of a lever having a two to one ratio. The other jaw, which, in operation, is stationary, is made adjustable to accommodate brake cylinder pistons of different diameters. The adjustment is provided by drilling two holes in the jaw, either one of which may be selected for the insertion of the lock pin, which is inserted through the jaw into a hole in the bench plate. The remainder of the details of the device are clearly shown in the drawing.

In Fig. 2 is shown a simple work stand for holding distributing valves of the No. 6 E.T. brake equipment. It permits the adjustment of the valve in any position for dis-

mantling, facing slide valve seats, fitting rings and assembling.

The device is made entirely from scrap material. The standard is a 14-in. passenger car type brake cylinder piston. The flange on which the distributing valve is mounted is

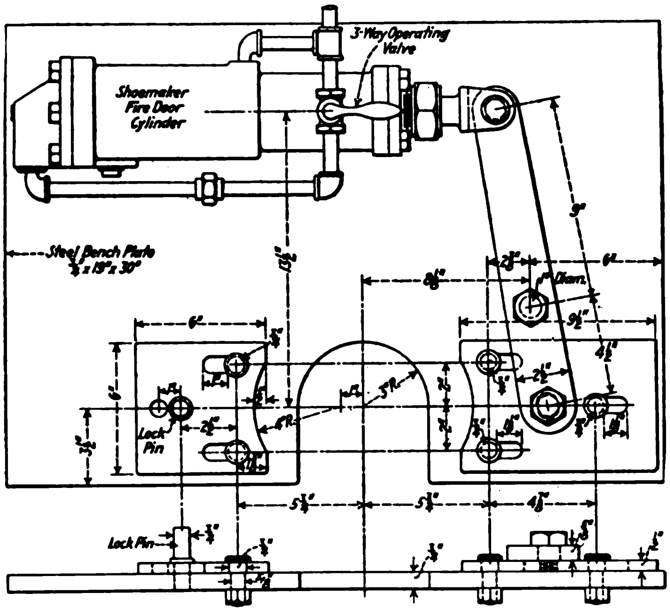


Fig. 1—A Power Vise for Holding Freight Car Piston and Non-Pressure Head While Changing the Packing

made of a 9½-in. air pump piston. The stem of the piston is passed through the jaws of a split nut, which permits the face plate to be rotated to any position, either about the axis of the stand or about its own axis. When once in the position desired, further movement around either axis is pre-

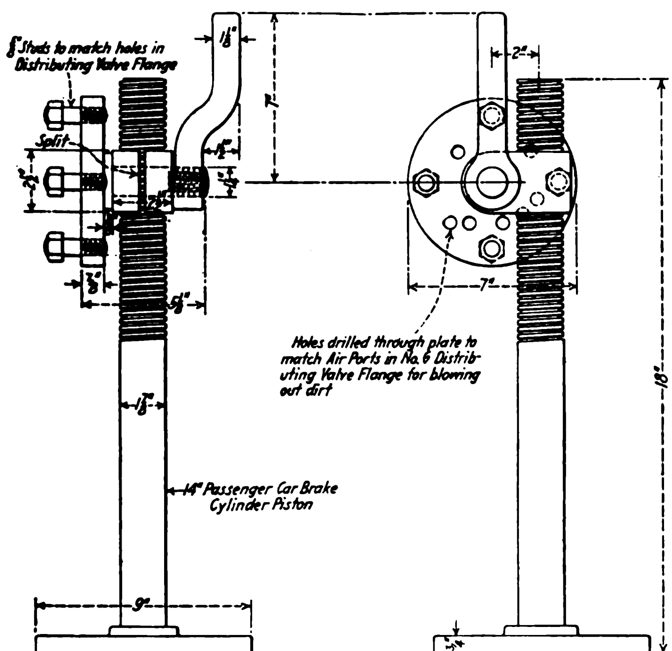


Fig. 2—An Adjustable Stand for Use in Repairing Distributing Valves

vented by tightening the binding nut on the end of the face plate stem.

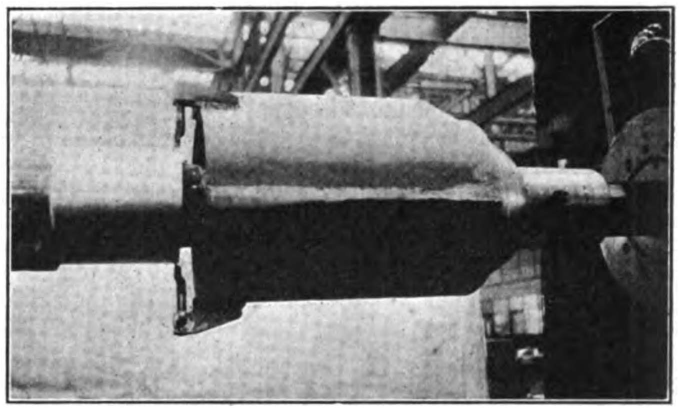
The face plate is fitted with studs which correspond with the bolt holes in the distributing valve flange. Holes are also drilled through the plate to register with the air passages in the distributing valve flange, to permit blowing out the passages with air pressure.

Turning Mounted Crank Pins on a Quartering Machine

By A. E. Nye

General Machine Foreman, Santa Fe, Albuquerque, N. M.

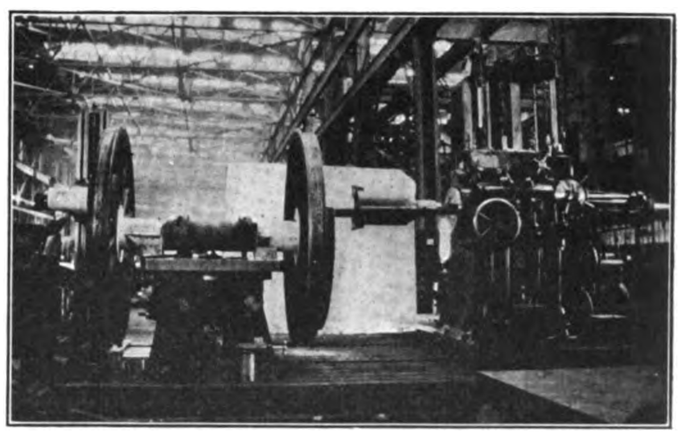
A DEVICE for turning mounted main crank pins on a Pawling & Harnischfeger horizontal boring and quartering machine is shown in the illustration. The wheels are set up with the axle resting in V-blocks which are tongued to fit the slots in the table. This method of setting the blocks places the axle in line with the spindle of the



The Turning Attachment Is Equipped with a Roughing and Finishing Tool

machine. The journals are calipered and any variation in size is remedied by placing shims under the smaller journal.

The first pin to be turned is plumbed with the center of the axle and the spindle of the machine is centered with the proof line on the end of the axle. It is then raised an amount equal to the stroke so that the center of the spindle is located at what should be the correct center of the crank pin.



With This Attachment All Setting Is Done with Respect to the Quarter and Stroke

This may be checked by graduations on the housing of the machine.

The turning attachment consists of a box, shown in the illustration, which is keyed to and extends out from the end of the spindle. It is a hollow cylindrical casting with two tool holders welded to the circumference opposite to each other. Two tools are used at the same time, the leading tool to do the roughing and the following tool the finishing. As

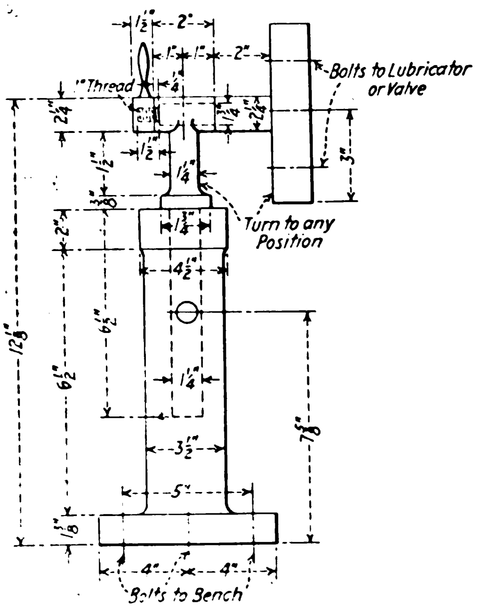
the cutting is done on opposite sides, the tendency to chatter is eliminated. One cut is generally sufficient to true the pin and leave a small witness mark.

The second pin is plumbed by quartering with the pin already finished and is then set for the stroke by the procedure already described. This system insures the pins being turned parallel with the axle. It also results in greater accuracy as all the setting is done with respect to the quarter and the stroke.

A similar attachment, but smaller in size, is used for turning the front, back and intermediate crank pins.

Lubricator and Air Brake Valve Holder

A CONVENIENT bench device for holding lubricators or air brake valves while being repaired, is shown in the sketch. A vertical plate, drilled to suit the holder on the bracket of the lubricator or valve, is attached to a pin 5¼ in. long and 2¼ in. in diameter. This pin is turned down to 1-11/16 in. in diameter, 2 in. from the back of the plate, and 1¾ in. along the pin where it is again turned down to take a 1-in. thread. The horizontal arm, which is 2 in. long, is cored to 1¾ in. diameter. As shown in the sketch, the pin, with the vertical holding plate attached, is passed through the horizontal arm and a hand screw tapped for a 1-in. screw thread is screwed on the end. This arrangement permits the workman to turn the lubricator or air brake



Sketch of Bench Device for Holding Lubricators or Air Brake Valve

valve to any position and hold it securely by tightening the hand screw.

The horizontal arm is cast integral with the standard, which has an extension of 6½ in. down into the base. The base is 9⅞ in. high and 8 in. in diameter, and is provided with four holes so that it can be bolted to the bench. A hole is drilled and tapped for a set screw 7⅝ in. from the bottom of the base and by tightening the set screw, which should be provided with a handle, against the extension, the standard can be held at any desired height. The vertical holding plate can also be held at any convenient angle to the front of the bench and locked in position. It has been found that this device facilitates the work, on account of the fact that it can be changed easily and quickly to any desired position and securely locked with comparatively little effort on the part of the workman.

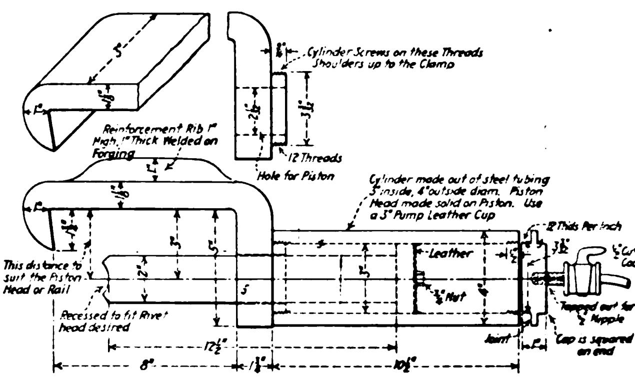
Holder-on for Bullring Rivets

By F. W. Lampton

General Foreman, St. Louis-San Francisco, Springfield, Mo.

A HOLDER-ON for bullring rivets is shown in the sketch. This tool was devised for holding on the rivets driven in a new type of bullring. There were many loose rivets resulting from driving and holding on with a long stroke hammer and a dolly bar. By using this tool and driving the rivet with a long stroke a good tight job could be obtained with less manual effort. The use of this tool eliminates one man from the gang.

This tool can be made at any shop as there is just one forging to be made. The cylinder is made out of tube stock. A reinforcement rib is welded on top of the forging so as to



This Holder-on Eliminates One Man on Bullring Riveting

give it added strength. The piston is turned out of a piece of steel at one end and conforms with the shape of the head desired on the rivet. The other end is turned to a working fit in the cylinder with a 3-inch pump leather studded on the end to make it air-tight. A removable cap is placed on one end of the cylinder so that repairs can be made and the tool inspected when needed. The other end of the cylinder is screwed on the forging proper. With 90 pounds of air on this piston you can be assured of a tight job on all rivets.

Revolving Tool Rack

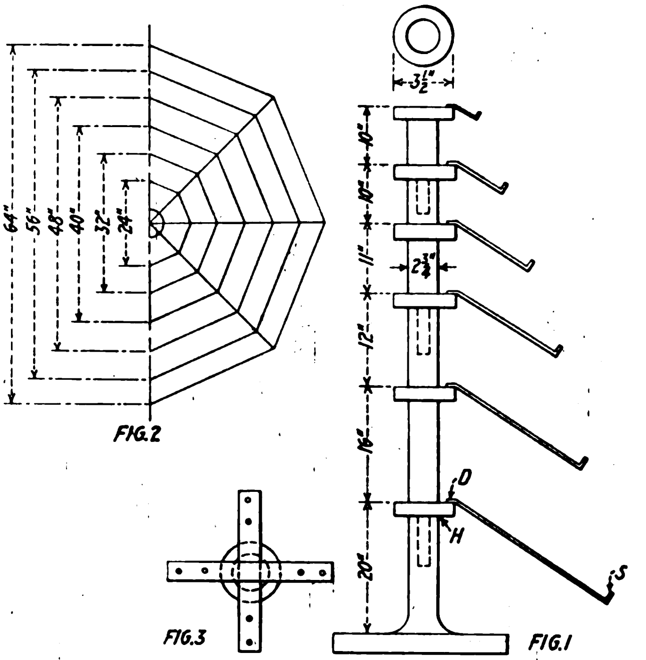
By Joseph Smith

A TOOL rack with a number of convenient features has recently been built and placed in service in the Lorain, Ohio, shops of the Baltimore & Ohio. Its construction and installation was under the supervision of K. E. Floeter, general foreman. As shown in the drawing, the rack is built in the shape of an octagon and the shelves are tilted so that the tools can be easily seen as they are revolved around the stand or center post.

Referring to Fig. 1, of the drawing, the center post is composed of four separate pieces. The lower portion is welded to the stand, Fig. 3, and the upper portion turns on a recessed collar, equipped with ball bearings, at *H*. This arrangement makes the rack easy to operate by the tool room attendant. The stand is made of 6-in. by 1-in. by 36-in. wrought steel and is constructed by offsetting one piece at the center so as to fit snugly over the other and then welding them together.

The tool trays are made from a ⅛-in. steel plate, pressed into the form of a cone frustum having the outlines as shown in Fig. 2. Each cone is made in two sections. This arrangement makes it comparatively easy to place a section on the

top of each collar on the center post and then weld at the point *D*. After both sections have been welded to the collar, the tray is then completed by welding the seams. Each tray has a slope of 30 deg. The flange *S* is made by allowing



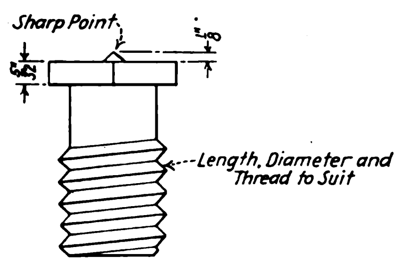
A Handy Rack for Tools That Is Being Used in a Railroad Shop

about an inch more of material than is required to make the cone and when the cones are bent to shape the flanges are turned up by hand.

Center Screws for Laying Off Bronze Hub Liners

By E. H. Fitcher

In laying out bronze liners for hub plates, or for the shoe and wedge faces of driving boxes, difficulty is sometimes encountered in locating the holes in the bronze plate because of the irregular location of the holes in the hub or shoe and



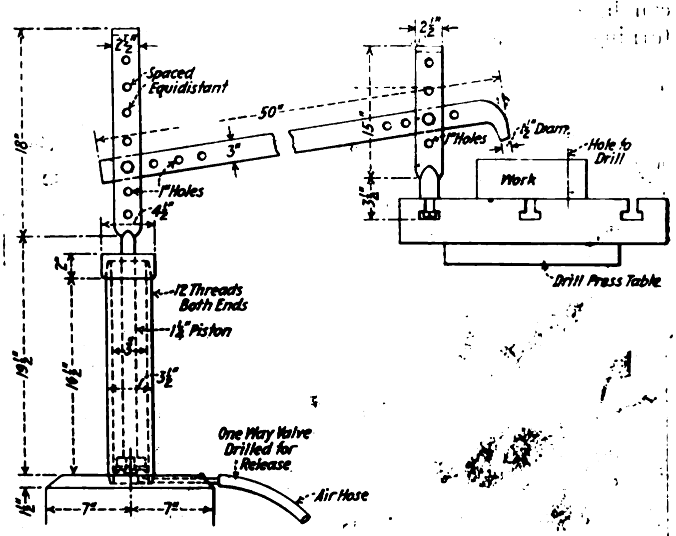
A Center Punch Stud for Laying Out Bronze Hub Plates

wedge faces. By the use of a special stud, shown in the sketch, this difficulty has been overcome. Accurately centered on the head of the stud is a sharp point, which serves as a prick punch. Before laying out the liners, these studs are screwed into the holes in the part to which the plates are to be applied. The plates are then placed in position and tapped lightly with a hammer. The sharp pointed steel stud center punches the bronze plates, which are then ready for drilling.

This device was developed by E. R. Woody, master mechanic, Chicago division, of the Chesapeake & Ohio.

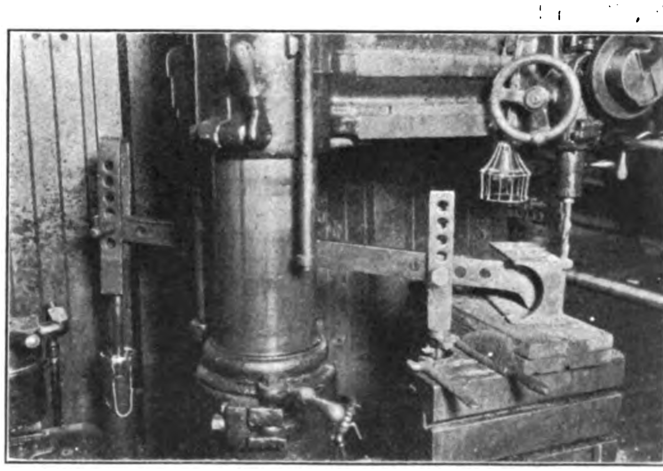
A Portable Air Clamp

A portable clamp, operated by compressed air, that has proved to be especially valuable for holding work on drill press tables, is shown in the illustration. The construction of the device is very simple and, as shown in the sketch, it contains few parts. It consists of a 14-in. base, to which is attached an air cylinder 3½ in. in diameter. The piston rod has an extension through which a number of one-inch holes, spaced equidistant, are drilled. The holding arm, or lever, is also provided with a number of one-inch



Sketch of Clamp for Holding Work on Drill Press Table

holes at the end. This arrangement allows the operator to vary the length of the lever arm or its height on the piston rod by simply changing the location of the pin. The lever arm also has a number of one-inch holes for purposes of adjustment at the fulcrum. It is 50 in. long and is forged down at the end to 1½ in. diameter. This end is turned down, as shown in the sketch, to hold the work securely on the table. The fulcrum consists of an upright forging which can be fitted into one of the grooves of the table. It is provided



View Showing Portable Air Clamp in Operation

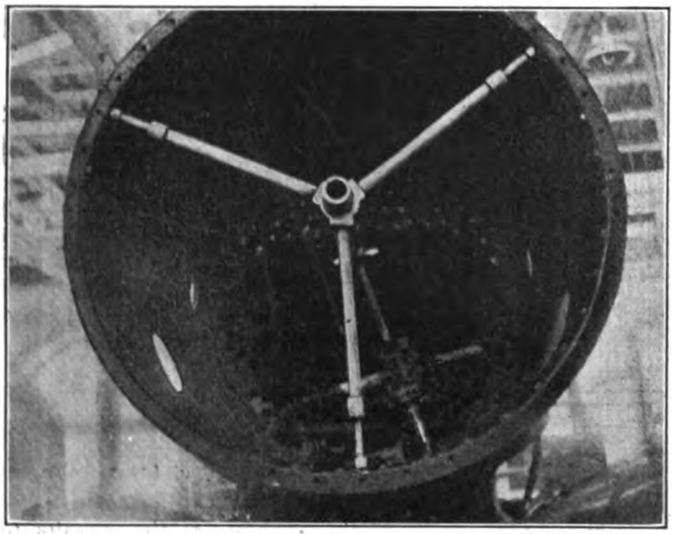
with one-inch holes spaced equidistant so that the height from the table of the holding end of the lever arm can be increased or decreased as required.

The illustration shows the clamp set up for holding work on a single spindle drill press. Its use saves considerable time, for all that is necessary to clamp or release the work is to operate the valve attached to the column of the drill press in a convenient location for the operator.

Jig for Drilling Cylinder Saddle Bolt Holes

By E. A. Murray
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

A CONVENIENT device for holding the air motor in a radial position while drilling bolt holes for the cylinder saddle, is shown in the illustration. It consists of a center bar, which is supported at the front end by three adjustable legs set into the smokebox ring. Each leg can be easily adjusted to different smokebox diameters by turning the studs that are screwed in the ends. The back end



This Device Holds the Air Motor in a Radial Position for Drilling

of the center bar rests in one of the tubes in the front flue sheet.

The feed screw of the air motor used for this work is made considerably larger than the standard screw and the top end is made fast to a sleeve that encircles the center bar. The device is strong enough to support the entire machine so that it can be swung to any desired position. It is simple in construction, inexpensive to make and has proved to be very efficient.

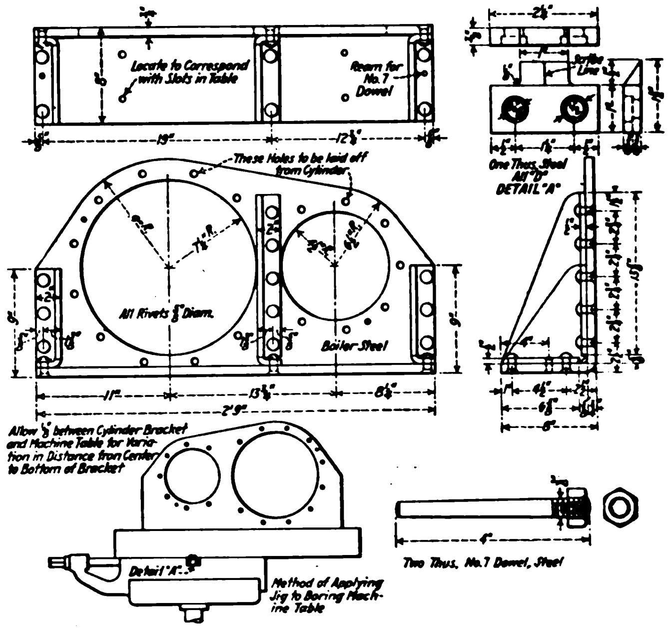
Jig for Reboring 8½-inch Air Pump Cylinders

By E. A. Miller

A JIG for reboring 8½-in. cross compound air pump cylinders on a horizontal boring mill, is shown in the drawing. It is made from a ¾-in. steel plate, bent at right angles so as to form a base 8 in. wide. The base is provided with holes which correspond to the slots in the table so that it can be bolted down in the usual manner. The vertical flange has two holes which serve as limit gages for the operator and is securely braced to the base by three reinforcing angle webs of ½-in. steel plate. The cylinder is bolted to this flange by means of the studs used to hold the cylinder head. The bolt holes can be laid off from one of the cylinders as the location of the studs is standard on all pumps.

In order that the jig may be set up square with the horizontal bar of the machine, two small holes are drilled and reamed in the base of the jig and down into the table of the machine for No. 7 dowels or taper pins. By placing the dowel pins in the holes before tightening the jig to the table it can be set up any number of times with the cylinder in perfect alignment with the horizontal bar. The dowel pins are provided with nuts on their upper ends, as shown in the drawing, and by giving the nut about two turns, the dowel is loosened, so that it may easily be withdrawn.

The detail *A*, which is shown on the drawing, is a mark-



This Jig Correctly Alines the Air Pump Cylinders for Reboring

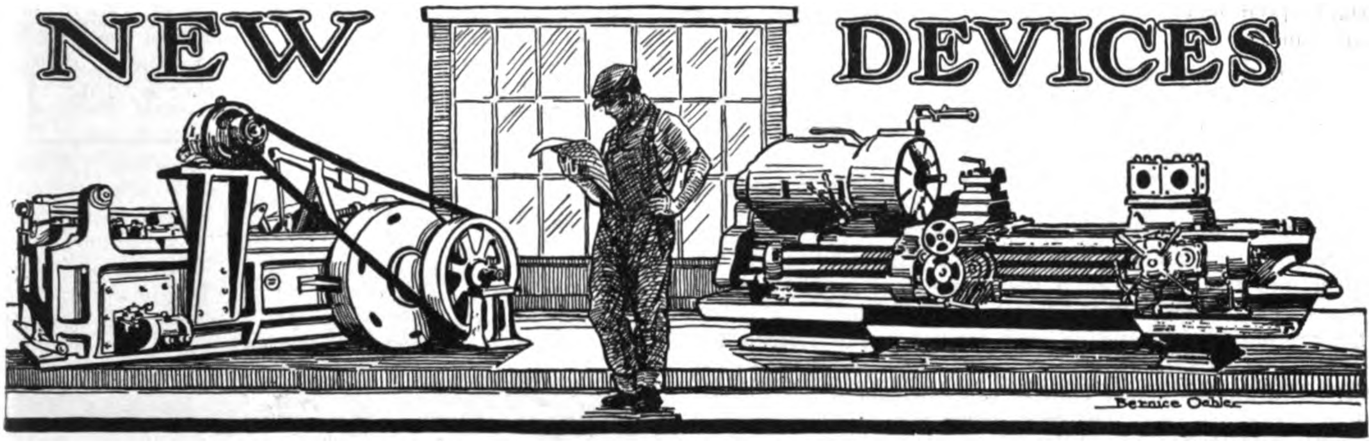
ing device which is fastened by machine screws to the stationary bed of the machine under the table. When once the jig is properly located, lines are scribed on the end of the table, one in the vertical plane of the centerline of each of the two bores. When setting for the high pressure cylinder, the proper line on the end of the table must be set opposite the line scribed on the marker, which indicates the correct position on the stationary bed. Then all that is necessary in order to rebore the low pressure cylinder is to move the table over 13¾ in. until the mark showing the second centerline coincides with the scribed line on the marker.

Reclaiming the Metal One-time Container

THE growing practice of using metal one-time containers for the shipping of paints, oils and other liquids has proved to be economical, with only a single exception, to many large railway systems. These metal containers have heretofore been thought incapable of being reclaimed for further service.

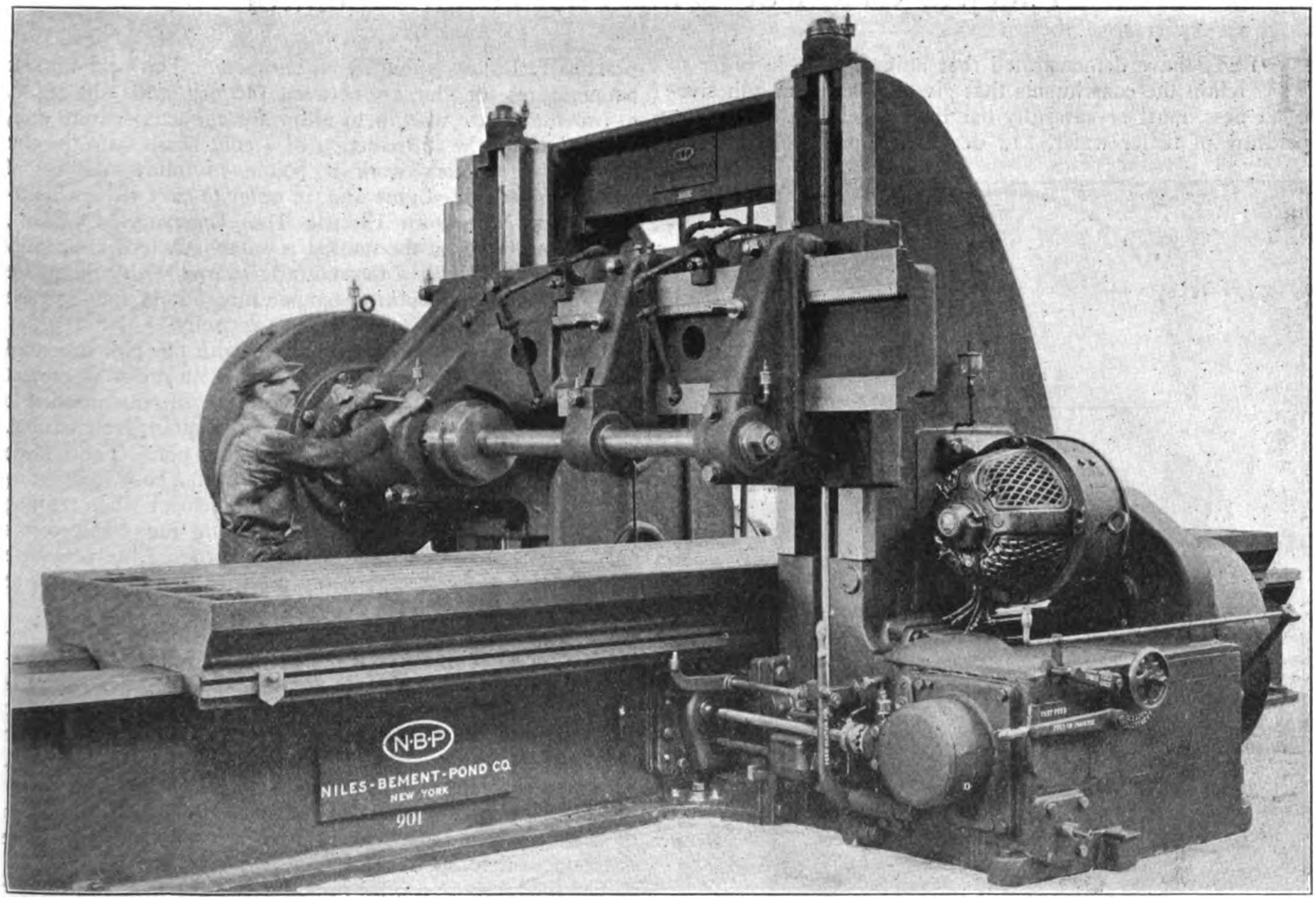
Many lines have experimented in salvaging the metal one-time container, but to date the Canadian Pacific seems to have made the most thorough investigation of the subject. Old paint pails are shipped to the Angus Shops after their contents have been used. Here they are dipped in a tank of hot Wyandotte solution. This removes the paint and leaves the sheet metal clean and practically as good as new, without affecting the surface of the metal or attacking the solder where the metal is joined together.

Making of the metal one-time container into a "many time" container is possible by providing shops with the cleaning solution.



A 58-in. Heavy Duty Locomotive Rod Milling Machine

A RECENT addition has been made to the line of heavy rod milling machines built by the Niles-Bement-Pond Company, Philadelphia, Pa. The machine is equipped with a 75-hp. motor, and will absorb the full motive power if the cutters will stand up to this demand. It is designed throughout so that should cutters become available that will withstand the increased hard usage, the machine may be equipped with a 100-hp. motor. Special attention has been given in the design to such features as smooth cutting action, suitable range of table feeds for the work, convenience of manipulation and proper lubrication.



This Machine Is Equipped with Gearing of Extra Strength in Order to Meet Cutting Demands That May Develop in the Future

The spindle is driven by a large manganese bronze worm wheel of coarse pitch, and this wheel engages a hardened steel worm fitted with a ball thrust. Both the worm and worm wheel run in a bath of oil. The large diameter of the worm wheel, together with the tangent type of gearing, tends to eliminate any chatter and preserves the edges of the cutters.

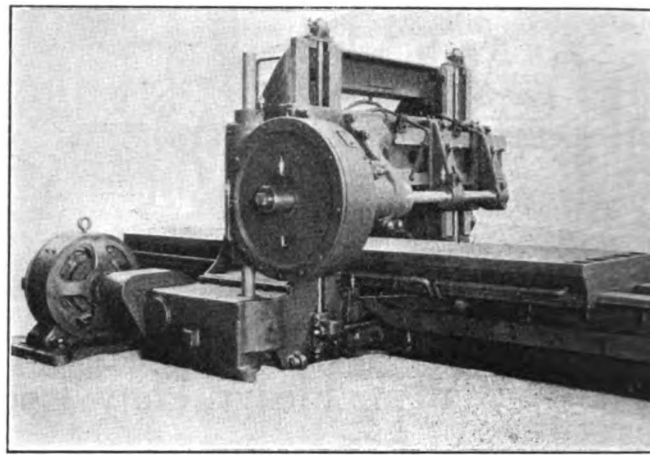
The drive shown in the larger of the two illustrations, is for direct current. A variable speed motor is used with the same range of speed as required by the cutter arbor. Thus a full speed range is obtained without the introduction of change gears. When only alternating current or a con-

stant speed motor is available, suitable change gearing is introduced.

The table has the usual power feeds and fast power traverse on the bed, operated by a separate motor. The power is transmitted by a bronze spiral pinion running in a pocket of oil which engages with a steel rack on the under side of the table. The cross rail has a rapid power adjustment in both directions as well as a power vertical feed for raising the cutter out of the work. The downward feed is manually operated as a safeguard against breaking cutters when sinking them into the work. Both the power feed and the rapid adjustment are operated by the same motor, which is wired to the driving motor panel in such a way that it stops when the driving motor is shut off. This motor also may be used for rapid traverse of the table or rail when the driving motor is not in operation. The feed motor has a special control so that it slightly eases off its pulling power when the cutter meets unusual resistance due to excess metal or hard spots.

The machine is equipped with a complete cutting fluid circulating and draining system. The fluid flows to the cutters by gravity from a tank in the top cross piece between the housings and drains from the table to a lower reservoir from which it is pumped back to the tank.

The distance between the housings is 58 in. and the over all width of the table is 54 in. The length of the table between the end pans is 16 in. and the maximum distance between the table and the center of the arbor is 32 in.



Rear View of Rod Milling Machine Designed for Heavy Duty

Electric Glue Pot With Thermostatic Control

TESTS have demonstrated that animal glue, in order to retain the constituents that give it maximum adhesiveness, must be carefully handled in heating. The temperature of boiler water, 212 deg. F., is much higher than the critical temperature of glue, which is about 155 deg. F. At this temperature glue begins to break up and, by evaporation, lose its most valuable elements, and at 185 deg., it has practically lost its value as an adhesive. The best working temperatures for glue are between 140 deg. and 150 deg. F. to provide a safe margin to allow for the temperature drop, which follows the introduction of a cold brush into the glue pot. Unsatisfactory work is bound to follow the use of under or over-heated glue and, in order to meet these requirements, the Van Dorn Electric Tool Company, Cleveland, Ohio, has placed on the market a water-jacketed, electrically heated glue pot with a thermostatic control which keeps the glue at the correct working temperature. It is made in one size only, with a pot of two quarts capacity.

Glue Pot Designed to Maintain Automatically the Correct Working Temperature

The glue pot is of cast aluminum with the rim machined to give an air-tight fit on the water pot, in order to prevent loss by evaporation. A drip ring returns all condensation to the water pot. The water jacket is a gray iron casting, ground to an air-tight fit with the glue pot. The outside of the water pot telescopes over a rim on the base, preventing any penetration of water to the heating element when refilling the pot. The necessity for replenishing the water occurs only at long intervals. By actual test, these glue pots have operated for three weeks before additional water had to be supplied.

The heating element consists of a nichrome ribbon, insulated by mica plates, and is moisture proof. Easy replacement of the heating element or of the automatic control is made possible by the simplicity of its construction. The crowned base presses the heating element solidly against the bottom of the water pot, to insure a perfect thermal contact. An asbestos plate and air chamber in the base adds to the heat insulation and tends to prevent any loss by radiation downward. The current consumption is low and the device is economical to operate.

The thermostatic control provides positive heat control that will hold the temperature of the contents of the glue pot at 150 deg. F., with a variation of less than 5 deg., regardless of room temperature. The thermostat is set at this point and is fully tested before the glue pot leaves the factory.

The device can be operated from an ordinary electric light socket, and it is equipped with a cable and separable plug. Its simple construction is shown by the cut away portion of the water jacket.

Alemite Lubricating System for Rods

THE Alemite lubricating system, developed by the Bassick Manufacturing Company, Chicago, has recently been extended to the lubrication of locomotive rod bearings, and is now being tried with considerable success on several roads. Briefly, the system consists of a large Alemite grease gun (Fig. 1) which can be quickly applied without threading over the end of a nipple (Fig. 2), the latter taking the place of the ordinary rod grease cup plug or cap. These nipples are turned into the grease cups and spot welded in place so that there is no possibility of their working out and becoming lost, a considerable item of expense in ordinary locomotive operation due to the actual cost of the caps which work off and, perhaps more serious, the opportunity thereby afforded for dirt and grit to get into the grease. The third element of the Alemite system as applied to locomotive rods is the smaller grease gun (Fig. 3) carried by each engineman to apply grease to the rod bearings as needed while on the road.

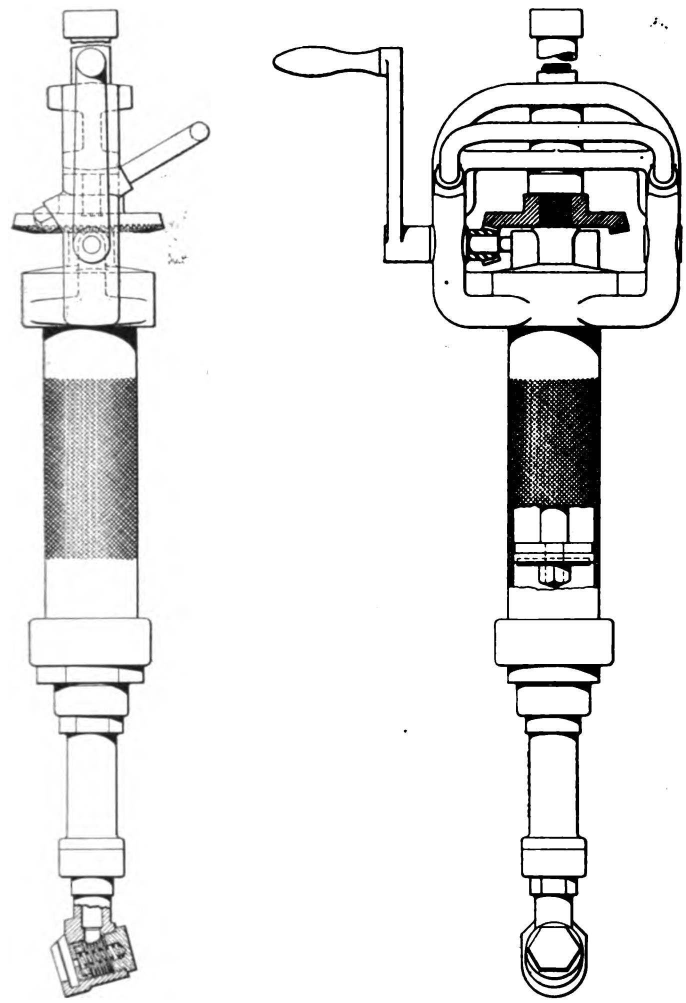


Fig. 1—The Large Alemite Grease Gun Used to Fill Rod Cups

In operation, the rod grease cups are filled at the roundhouse before starting a trip with the large gun illustrated in Fig. 1. The arrangement of this gun to fit over the end of the nipple is apparent, as is also the powerful gearing arrangement for forcing hard grease through the ¼-in. hole into the grease cup. Pressures up to 2,500 lb. per sq. in. are said to be obtained by turning the long handle which moves the piston through a threaded spindle and gearing arrangement. Friction on the large gear is greatly reduced by means of the ball thrust bearing illustrated. The leather *L* and spring *S* in the end of the gun are so designed as to take care of slight irregularities in the nipple ends and prevent the leakage of grease when the gun is first applied. After pressure is developed in the gun, the leather is held against the nipple with a heavy pressure and no grease can be forced out except to the grease cup.

Referring to Fig. 2, which shows the nipple, *A* is the shoulder over which the grease gun fitting is applied. The valve *B* and spring *S* are so arranged that hard grease can enter the nipple, but as soon as the pressure is relieved the valve seats and prevents the entrance of dirt or other foreign matter.

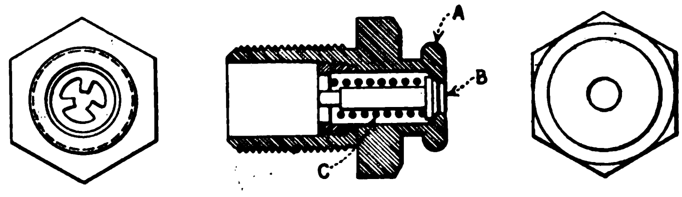


Fig. 2—The Nipple Which Replaces the Ordinary Grease Cup Plug or Cap

Probably the main advantage of the Alemite lubricating system as applied to locomotive rods is in the better lubrication provided. With reasonable care in filling the gun, clean grease can be applied to the rod bearings with no danger of cinders, dust and dirt being included as is too often the case under present methods. Enginehouse men assigned to the duty of filling rod grease cups do not always realize the importance of keeping the grease clean, and even with the best of intentions under present methods the cylindrical sticks of grease often contain more or less dirt picked up when they are laid on the rods or possibly fall to the ground. The Alemite system is designed to prevent foreign matter getting into the grease and eventually to the rod bearings in this manner and hence tends to improve the efficiency of rod lubrication and prevent cut and hot bearings.

The prevention of lost grease cup plugs and caps is an important advantage as is also the considerable saving in time effected by the Alemite system, both in filling grease cups at the enginehouse and in applying grease to the bearings as needed on the road. The grease gun fitting is simply applied over the end of the nipple and a few turns of the handle will do the work, whereas the older method requires that the plug or cap be threaded into and out of the grease cup possibly several times before sufficient grease can be forced in to fill the cup.

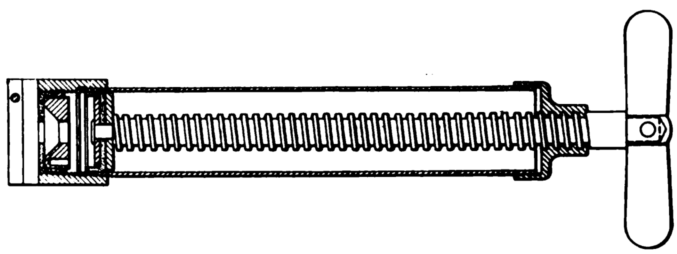


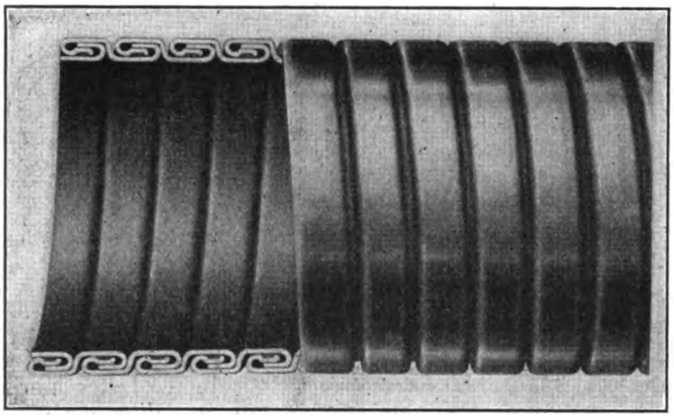
Fig. 3—The Small Grease Gun Carried by the Engineman

An important safety feature of the Alemite system results from the fact that should a rod bearing become hot, grease can still be forced into it with the grease gun without danger of the engineman being scalded with boiling grease. Serious burns sometimes result when enginemen apply grease to a hot bearing and attempt to thread the plug or cap back into the cup by hand.

Flexible Metal Hose Adapted to Railway Use

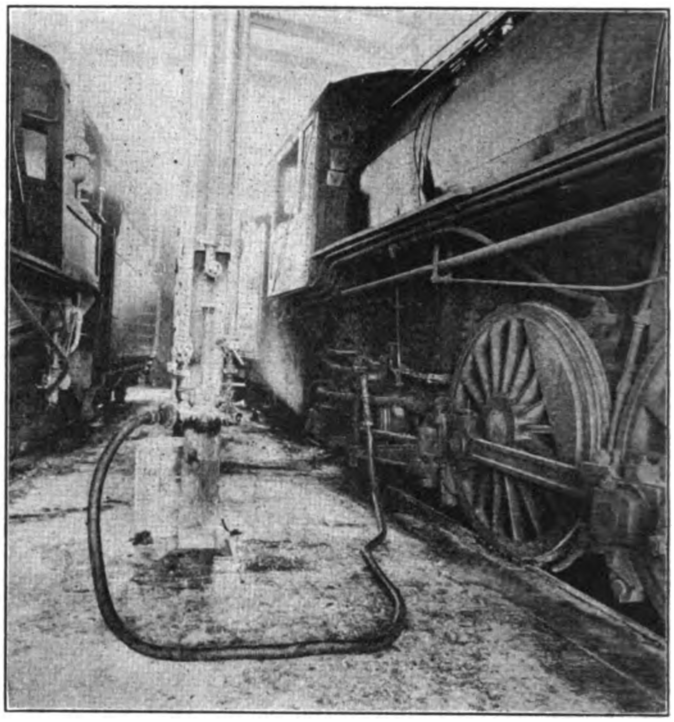
CONSIDERABLE interest is being taken by railroad men in the application of metal hose to railroad requirements. Rubber hose has been used extensively for many purposes, including the conveyance of hot water and steam under pressure. However, when it is used for hot water or steam, the rubber has a tendency to deteriorate rapidly and, as a result, has been the cause of many serious injuries to railroad employees. Unless rubber hose is renewed frequently, its use for such purposes involves an ever present element of danger.

To eliminate such difficulties, the American Metal Hose Company, Waterbury, Conn., has developed a flexible metal hose that is adapted to a wide variety of uses. It is specially adapted to railroad work as a high pressure hose, which may be used for boiler washing, blowing boiler tubes and for general service around enginehouses. It may also be used for such work as unloading tank cars, carrying oil and other heavy or inflammable liquids.



Sectional View of Flexible Metal Hose Showing How the Strips Are Interlocked

As shown in the cross-sectional view, the hose is manufactured from a continuous strip of bronze or galvanized steel of high tensile strength. The strip is first profiled to the desired shape and then wound spirally over itself. During the winding operation, a packing in cord form is fed in place between the metal surfaces, thus making a tight joint. The hose is made in various sizes ranging from 3/8 in. to 6 in. inside diameter. The 3/8-in. hose can be bent to form a circle 9 in. in diameter, while the 6-in. hose will form a circle 72 in. in diameter. Two types are manufactured. It requires approximately 1,000 lb. per sq. in. of hydraulic pressure to burst a 3/4-in. hose of the lighter type of construction, while the bursting pressure of the same size in the heavier type is 2,500 to 3,000 lb. per sq. in.



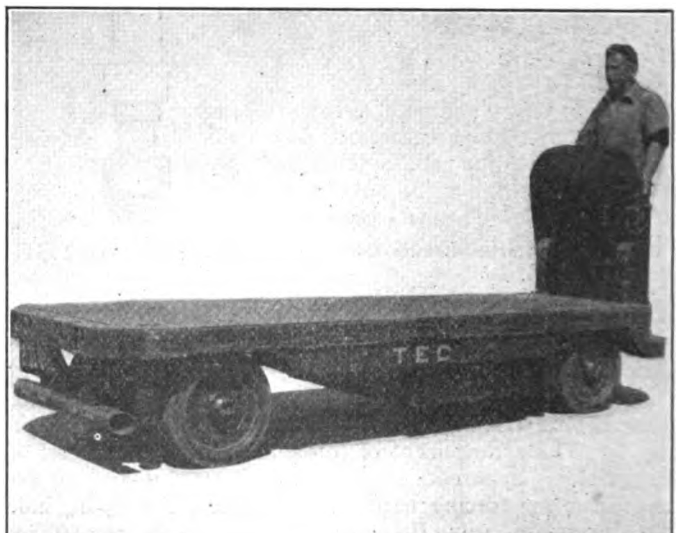
The Hose Is Suitable for Conveying Hot Water or Steam

A Long Wheel Base Truck for Bulky Material

A LONG wheel base truck has been added to the line of the Terminal Engineering Company, Inc., New York. It will carry a load of 5,000 lb. and is intended to handle bulkier goods than can be placed on the shorter wheel base model of the same capacity.

This truck is provided with a drive and handling features identical with those of the shorter models manufactured by this company. It has a four-wheel drive, each wheel being provided with a vehicle type motor enclosed in a weatherproof case. Steering is accomplished with all four wheels, making possible a short turning radius even though the wheel base measures 91 in. The operating controls are so situated that the driver's hands are entirely within the outer edges of the truck, thereby protecting them against injury.

The truck is carried on four full leaf springs and the wheels have 20-in. by 5-in. solid rubber tires. The brakes are of the internal expanding type. Only two of the wheel units are equipped with brakes. However, as they are all alike in general construction, the other two wheels may be provided with brakes if desired. The large wheels, individual drive and springs are intended to permit the use of this truck without having to construct special runways, as it is able to traverse a cinder fill, or run under adverse conditions.



This Truck Is Designed for Carrying Heavy Loads up to 5,000 lb. and Hauling Trailers

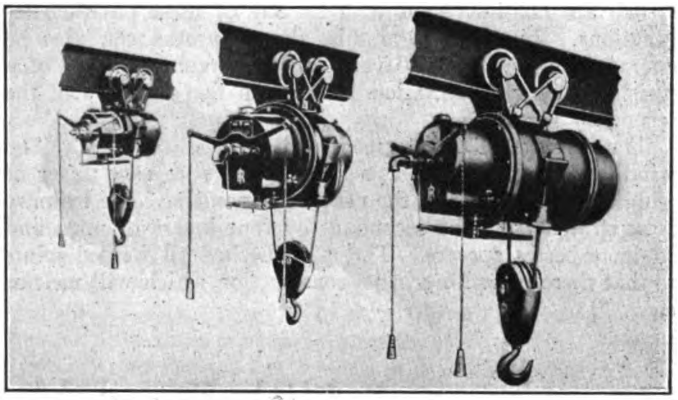
An important feature of this truck is that it is designed to use separable bodies. These bodies are constructed of wood and stand on legs so that they can be picked up by driving the truck under them. The truck is equipped with four screw jacks, one at each corner of the carrying area, that are operated by a motor with the same frame and characteristics as those used on the wheels. It is claimed that these jacks can elevate in five seconds a loaded body from the ground to the full height of 9½ in. The load may be carried in a partially raised position if desired and provision has been made for slippage at both the top and bottom of the jack stroke to avoid jamming.

The truck has a spring drawhead so that it may be used as a tractor if occasion requires. Because the entire weight rests on the driving wheels, the tractive effort is sufficient to move heavy loads, such as spotting freight cars, or hauling large machines and castings on trailers. The coupler is automatic and can be released from the operator's position. Head and tail lights are provided so that the truck may be used at night or indoors where the light is dim.

A Line of Air Motor Hoists in Five Sizes

THE Ingersoll-Rand Company, New York, is now offering a new line of air motor hoists, including five different sizes ranging in capacities from 500 lb. to 10,000 lb. This contains a number of distinctive features and are suited for a wide range of service. The smaller hoist of 500 lb. capacity was described in the November, 1923, number of the *Railway Mechanical Engineer.* The four larger sizes, just developed, are of similar design, except for a few variations in the gearing on the two heavier sizes.

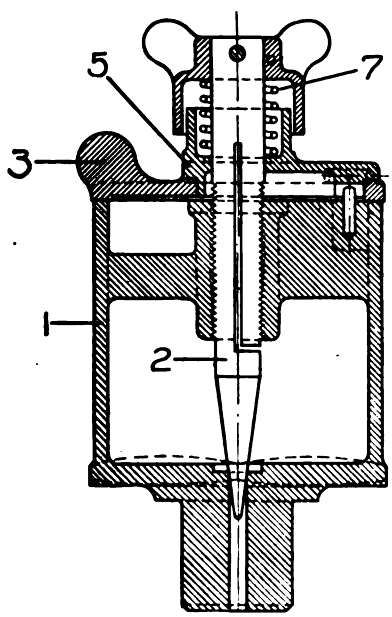
These hoists are compact in design, require little head room and are relatively light in weight. All of the five sizes are equipped with an automatic brake which holds the load positively under all circumstances. Thorough lubrication of all parts has been provided. The motor operates in a bath of oil with passages leading to all bearings, and the gears turn in a heavy grease. The motor and gears are both enclosed. Ball bearings or bronze bushings have been provided at all points necessary to add to the efficiency or life of the hoist. The throttle graduation on these hoists is fine, which ensures instant and complete control of the hoist at any speed. A safety stop lever is provided which closes the throttle when the load reaches the top.



Three Representative Types of Hoists Ranging from 500 lb. to 10,000 lb. Capacity

Oil Cup for Guides and Valve Stems

AN oil cup designed to maintain a uniform oil feed while the engine is in motion, to provide for quick filling, to prevent the loss of the cover and the entrance of dirt into the oil reservoir when the cover is being removed for filling, has recently been introduced by the Nathan Manufacturing Company, New York.



This Oil Cup Is Designed to Maintain Uniform Oil Feed, Unaffected by Vibration

Referring to the drawing, a uniform feed is controlled and maintained by the spindle, 2, much in the usual manner, except that it is made slightly oversize and slotted. This oversize, together with the spring under the winged cap, creates sufficient friction to prevent the spindle from turning due to vibration. This feature assures uniformity of oil feed once the spindle is set.

The method of securing the cover, 3, to the body of the oil cup, facilitates filling. Furthermore, the cover cannot be lost off, nor can dirt get into the oil. The cover can be swung in either direction around the fixed cap, 5, by pressing against the projecting fin on the back. When it is swung away from the closed position a liberal opening is exposed for filling the cup. When the cover is returned to the closed position it is caught by a clip and is positively locked. Liability of losing the cover is practically eliminated as it cannot be removed without first removing the spindle. When opening, it slides over the finished surface of the top of the oil cup body, thus wiping off any dirt that might adhere to it. Malleable iron, instead of brass, is used for the body of the cup because of its lower cost. There is also less likelihood of malleable iron cups being removed from locomotives standing in yards or roundhouses. All parts are made interchangeable, which is an important feature in their maintenance. As shown in the drawing, this oil cup has only seven principal parts that are necessary to maintain. These parts are easily accessible for renewal.

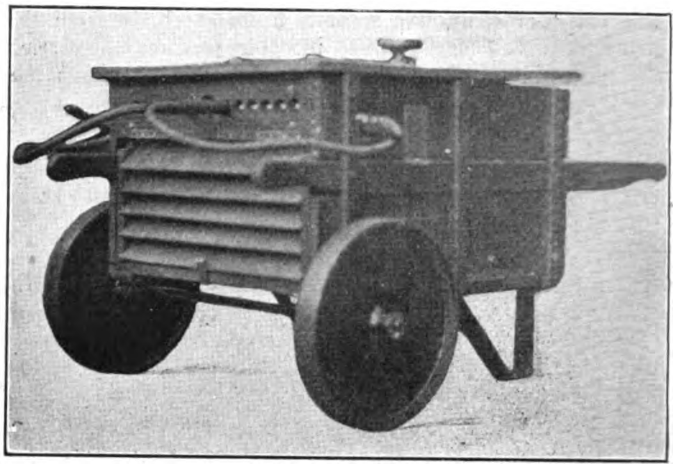
A One-Man Portable Universal Welder

A NEW type of welding transformer has been developed by the Electric Arc Cutting & Welding Company, Newark, N. J. It is called universal because it can be operated from almost any shop supply circuit whether it is alternating or direct current and the manufacturers offer it for doing all kinds of arc welding and also for nickel spotting, lead burning and spot-tack welding.

Previous designs of welding transformers made by this company could be used on alternating current voltages such as 220-440 or 110-220. This unit which is no larger than the regular size can be used on the 110, 220 or 400 volts alternating current by means of multiple, series-multiple and series combinations of the coils of the primary winding. To make the same machine operate on 25 and 40 cycles, taps and adapter windings are used to obtain the proper electrical characteristics. Operation of the blower and automatic switch are not interfered with by any of these circuit combinations. In addition to this, the apparatus can also be operated on 110 and 220 volts direct current by means of a resistor-reactor combination inserted in the circuit with the secondary winding.

The core of the transformer is made of silicon steel. The windings are of double asbestos magnet wire each layer of winding separated from the next by pure mica. The primary is separated from the secondary by four layers of mica and 1/4-in. asbestos spacers. The machine has all welded joints so that there is nothing in its construction which will melt or char.

Previous designs of these welders, which weigh about 200 lb. were carried by two men. The machine has now been made easily portable by one man by the addition of wheels

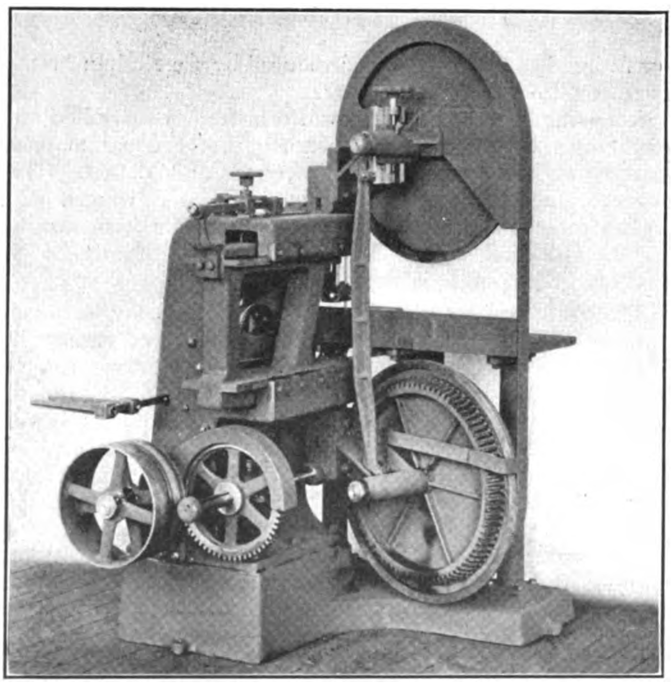


Barrow-Type Universal Arc Welding Machine

at one end and an extension of the side handles at the other so that it can be moved about like a wheel barrow. The machine is furnished either with or without the wheeling arrangement.

A High Speed Metal Cutting Band Saw

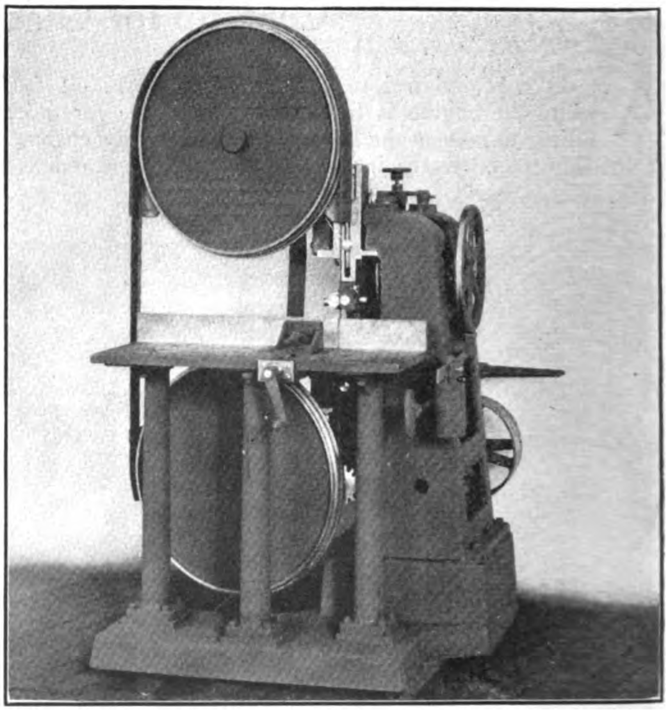
THE Stockbridge Machine Company, Worcester, Mass., has designed a band saw to cut all kinds of metal. The designers have disregarded all previous construction in order to obtain a pressure of the saw teeth against the work



Rear View of Machine Showing the Method of Mounting the Disk Wheels

that would be subject to fine adjustment and when once set be automatic in its operation.

This machine, known as the H & R high speed metal band saw, consists of a base on which is mounted the column and work table. In the column is a carriage, or ram which slides on scraped ways. Disk wheels for carrying the band are



Front View of Metal Cutting Band Saw Showing the Friction Feed Control

mounted on the carriage, as shown in the illustration, and move with it. The band is carried between two sets of guide rolls directly above and below the work. The top rolls are

adjustable vertically for different sizes of stock and are placed square with the ram. Attached to the ram are weights which move the ram forward and keep the band against the work at a constant pressure.

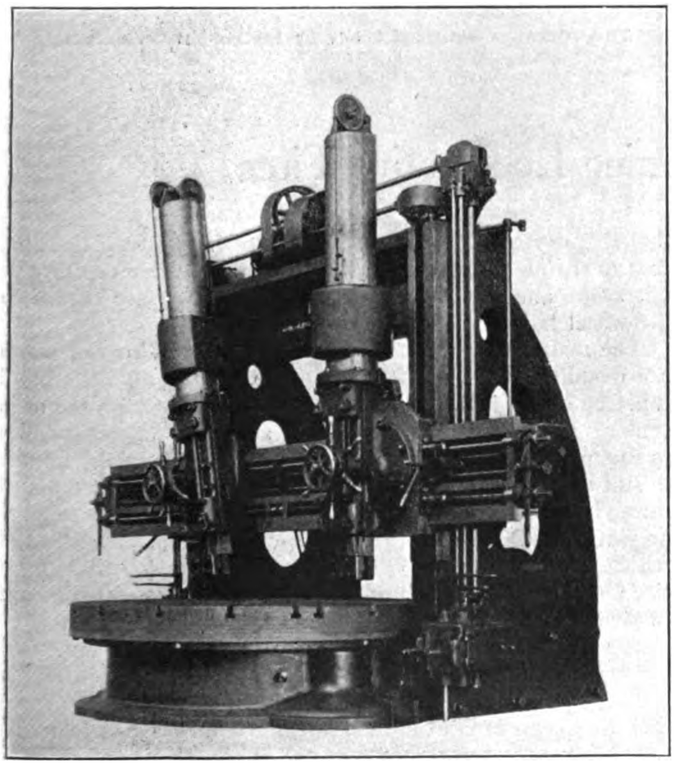
On the side of the column is a wheel which moves through a gear and rack with the movement of the ram. A friction pad rubs against the surface of this wheel and controls, by means of a balancing weight, the feeding of the ram forward as well as the pressure of the band against the work. The position of the weight determines the rate of feed to the ram. A balanced pressure control is obtained without an elaborate mechanism, by means of the pull of the weight on the ram and the friction on the wheel. An automatic stop may be set to stop the feed at any point of the stroke.

The saw is designed for high speed cutting and all parts are made of substantial and rigid construction. Both the fixed and the tension guide rolls are carried on roller bearings and all bearings are provided with dust-proof caps. The guide rolls are hardened and ground. Specially designed self-oiling bearings in the band wheels keep the shaft constantly flooded with oil. A tension screw carried in a pivoted slide, keeps the band taut and in alinement. The saw blades are 1/32 in. in thickness.

The machine can be furnished for either belt or motor drive. It is built in three sizes, cutting either square or round bars up to 6 in., 9 in. and 12 in., respectively.

A 100-in. Double Driven Vertical Boring Mill

A NUMBER of important improvements of special interest have recently been made to the 100-in. double driven vertical boring and turning mill built by the Betts Machine Works of the Consolidated Machine Tool Corporation, Rochester, N. Y. The outstanding feature is that a more powerful drive has been accomplished by means of two spur pinions meshing with an internal gear of wide face and coarse pitch. These double pinions are keyed to the shafts so as to mesh evenly with the table gear. There is a full bearing on both pinions and being located on opposite sides of the gear, a smooth drive is produced. This drive makes the machine particularly applicable to work requiring heavy cuts in steel castings with coarse feeds.



Betts Vertical Boring Mill with Double Drive

The table, which is of extra thickness, is mounted on a long spindle provided with taper bushings for adjustment of wear at both top and bottom bearings. These bushings are provided with a means for automatic lubrication of the bearings. The saddles and tool spindles have eight feeds which are entirely independent for each side of the machine. The feeds are obtained through sliding steel gears which can be changed instantly from one to another while the machine is running.

The power rapid traverse to the saddles and tool spindles is driven by a motor on top of the machine, which is also used for raising and lowering the crossrail. The arrangement of the power rapid traverse is such that there are no idle running shafts or gears. The top mechanism is not in motion except when the power rapid traverse or crossrail elevation is being used. The feed and power rapid traverse are positively interlocked by a cam arrangement which throws one out before the other is engaged. Both the power rapid traverse and feeds may be engaged, disengaged or reversed directly from the saddles by means of levers located on the operator's side of each saddle. Duplicate stationary levers are provided on each side of the mill for use when the crossrail is in a high position. An interlocking lever is provided at each end of the crossrail for selecting the horizontal or vertical movement. Friction clutches protect the machine against damage and enable all movements to be made rapidly. The crossrail feed screws and elevating screws are provided with roller bearings for taking the thrust. Patented adjusting miters, graduated in thousandths, are carried directly on each saddle in a convenient location for the operator while making final hand adjustments for positioning the tools both horizontally and vertically.

The tool spindles are counterbalanced by means of ring type counterweights, designed to operate at all angles. This arrangement eliminates cumbersome overhanging chains and sheaves and greatly improves the appearance of the machine. The tool spindles also have a friction locking device for operating the rack pinion, which allows the operator to raise or lower the spindle quickly by hand.

The crossrail has a wide facing which is provided with a narrow guide and its construction is carried back between the uprights in order to give sufficient stiffness when the heads are near the center. It is clamped to the upright flanges at both the inside and outside, making the whole machine practically one solid unit.

The driving motor is geared direct to the speed box. On alternating current driven machines, the speed box provides 12 table speeds in geometric progression through hardened steel sliding gears. This drive is furnished together with a friction clutch and brake for starting and stopping the machine from either side, independent of the motor.

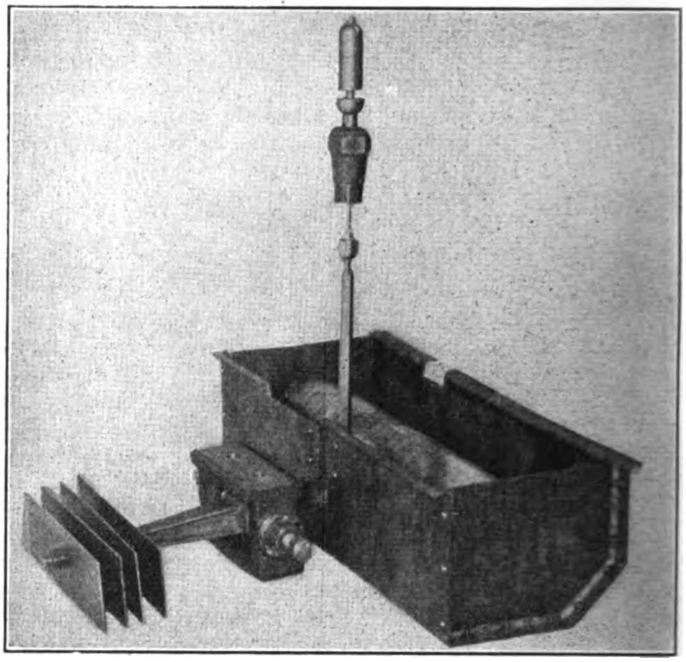
Machines with direct current motors have three mechanical speed changes which, in connection with a 3 to 1 adjustable speed motor, gives a total speed range of 27 to 1. A field rheostat and dynamic brake in the motor controller, operated in connection with a push button control, provides a means for instantly stopping or changing the speed as the operator may desire.

Low Water Alarm of the Float Type!

A NEW low water alarm, differing in principle from other devices of this character, is being manufactured by the United States Metallic Packing Company, Philadelphia, Pa. This device, known as the Security low water alarm, employs no fusible plugs of any kind, but is actuated solely by the height of solid water over the crown sheet.

A cylindrical buoyant float is secured to the end of the rocker arm shown in the illustration. This rocker arm is pivoted in a bracket so that the float rises and falls with the variation of the water level in the locomotive boiler. The bracket which supports the rocker arm is located so that the center of the pivots is five inches above the crown sheet. When the water in the boiler is five inches above the crown sheet, the float causes the needle on the end of the vertical rod to seat in the whistle and the float can rise no higher above the crown sheet. When the water in the boiler is reduced to a height less than five inches above the crown sheet the float, now resting on the surface, will fall as the level of the water in the boiler becomes lower. The weight of the float pulls the needle valve away from the seat in the whistle and this sounds a warning, calling the engineer's attention to the low water condition.

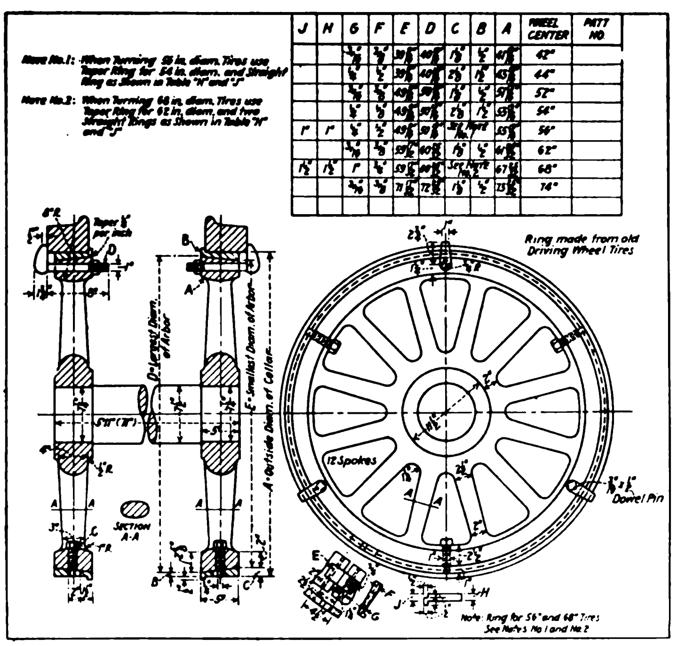
The cylindrical float which controls the sounding of the whistle is encased in a sheet iron baffle box. The purpose of this baffle box is to break up any surging or pyramiding of the water so that the whistle will not sound unless there is an actual condition of low water. Secured to the balance lever on the opposite side from the cylindrical float is a series of plates. These plates present the same surface area for corrosion as is presented by the cylindrical float. Any corrosion or scale formation is thus equalized on both ends of the rocker arm.



This Alarm Is Actuated Solely by the Height of the Water

Expanding Arbor for Turning Locomotive Tires

WITH the purpose of overcoming some of the difficulties encountered in turning unmounted tires, E. J. Brewster, Chicago, Ill., has patented an expanding arbor, the details of which are shown in the drawing. It is claimed that this device eliminates the necessity for heating the tires, first to shrink them on the wheel centers used for the turning operation, and then to remove them after they are turned on the wheel lathe.



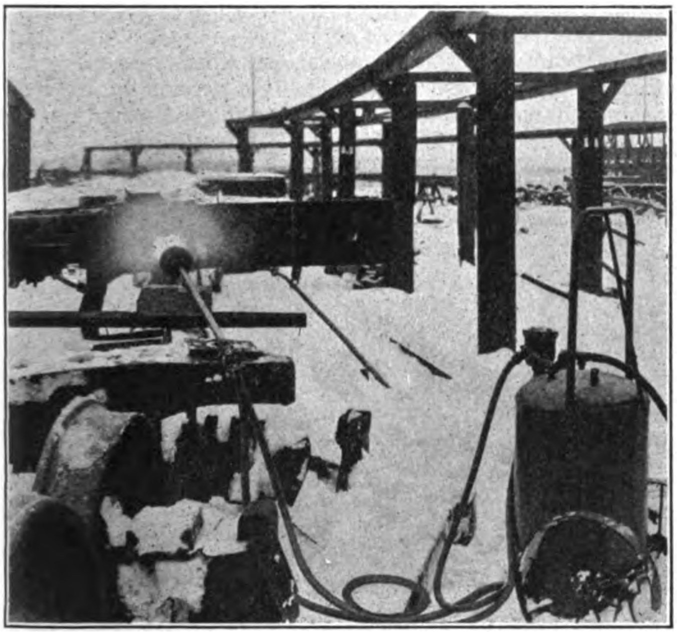
An Expanding Mandrel for Holding Unmounted Tires While Being Turned

The main center of the arbor is shown at *A*, two of which are mounted on the shaft or axle. A split band *B* is bored tapering on the inside to fit a corresponding taper on the main center. This band is provided with a shoulder against which to line up the tire and it may be made in different thicknesses to suit different sizes of tires. Retaining screws *C* are placed through the rim and project into slotted holes in the band to keep it from falling off in case the centers are being handled without tires on them. The bolts *D* are used to tighten the tire on the arbor. The block *E*, is provided to keep the band in shape sideways and is used only on thin bands. It is inserted under the tire at the point where the band is cut. The block has a slotted hole in order to hold the band in line as well as to allow it to expand. When the bands are expanded and the wheels are put in the lathe, the tendency of the drivers is to tighten the tire on the centers. This allows the operator to take cuts up to the capacity of the machine. After the tires are turned, all that is necessary is to remove them from the lathe, loosen the bolts *D*, and strike the tire on the inside with a sledge.

It is claimed that the expanding arbors will hold a set of tires even though the inside bore should vary as much as ¼ in. in diameter, and that this device will insure round tires, eliminating the possibility of getting too much strain on them, as is apt to occur while shrinking them on arbors which require excessive shimming. It is difficult to mount wheels by shimming and there is also possibility of a poor fit.

An Oil-Burning Torch Equipped with Vacuum Atomizer

THE Johnston Manufacturing Company, Minneapolis, Minn., has improved the nozzle on its high lift vacuum car repair torch, described in the December number of the *Railway Mechanical Engineer.* The apparatus includes two nozzles. The smaller one is made of cast iron and the larger one of cast steel in order to insure lightness and at the same time hold its shape while in service. Both sizes are now equipped with an atomizer located in the torch head and inside the nozzle. It is designed to eliminate any sensitiveness of the flame to motion or jarring and also to give a dependable vacuum at extreme high lifts. The continuity of the flame is not dependent on a hot nozzle or any other means outside of the atomizer itself. The expansion of the atomizing air produces a partial vacuum by which the oil is drawn from the tank. Tests have shown that it has the ability to operate at high lifts and has sufficient excess capacity and dependability for operation under extreme conditions, such as cold weather, rain, snow, or wind.



High Lift Vacuum Torch Designed to Operate Under Adverse Conditions

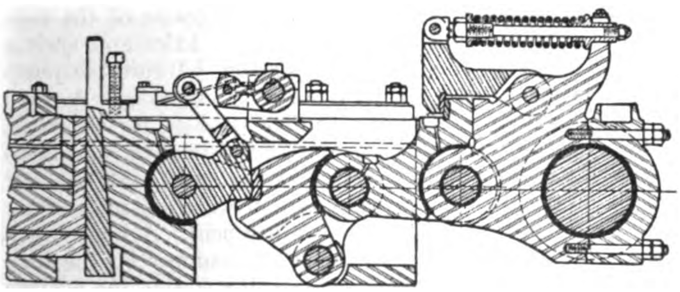
The air pipe, made of ¾-in. standard wrought iron pipe, constitutes the torch handle. This is screwed into the torch head at one end and into the air cock body at the other. The oil pipe is inside the air pipe where it is fully protected. It may also be repaired easily with the facilities available in any shop in case the torch should meet with a serious accident.

The air is controlled by a spring loaded air cock. The oil is controlled by a needle valve of such construction that it will not stick and become inoperable due to the effect of heat. The hose is attached to the fittings with compression coupling nuts that give a smooth external surface. A special compound is used for applying the hose to the couplings in order to preserve the rubber lining of the hose and complete a connection as strong as the hose itself. The hose connections to the tank are made by substantial brass unions that may be tightened by any small wrench.

A Rocker Type Drop Lock for Forging Machine

A NEW stop motion device called the rocker type drop lock, has been developed recently by the Ajax Manufacturing Company, Cleveland, Ohio, for its new model bolt heading upsetting forging machines.

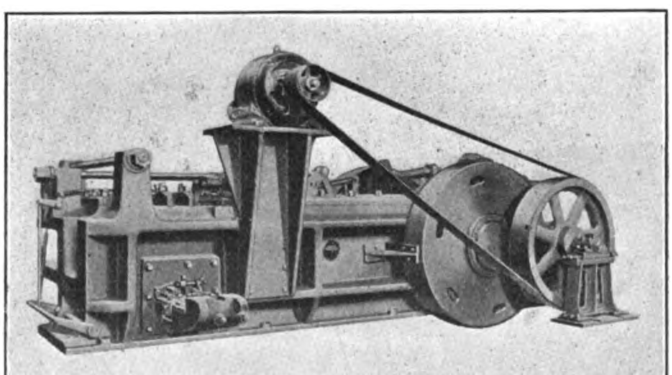
The operation of the lock is somewhat similar to a press; that is, the slides remain at rest until the hot stock is located



Sectional View Showing the Drop Lock Engaged with the Rocker Pitman and Crankshaft

in the impression in the stationary die and the machine is tripped. The usual method, in machines controlled by the operation bringing the slides into action, is by engaging a hub clutch in a revolving gear or flywheel directly into the end of the crank shaft while it is at rest. As this requires the sudden picking up of the crank shaft to full speed, a severe shock cannot be avoided when such heavy parts are involved.

The drop lock device has been designed to provide an entirely different action. The crank shaft, with the pitman attached, is in idle rotation when the slides are at rest. The wrist pin end of the pitman is carried by an oscillating rocker fulcrumed at the bottom of the header slide, and while the machine is idle this rocker swings free under the drop lock, as shown in the drawing. When the treadle is depressed, the lock drops onto the upper surface of the rocker and rides on this surface until the rocker reaches its extreme back travel where the lock is engaged. This engagement



The Ajax New Model Bolt Heading Upsetting Forging Machine

occurs, just as the crank shaft passes over its back dead center. The velocity of the reciprocating and oscillating parts is practically zero when engaged and the slides are thrown into motion without shock for as many strokes as desired. Upon the operator removing his foot from the

treadle, the lock is disengaged and the slides come to rest at their extreme back travel.

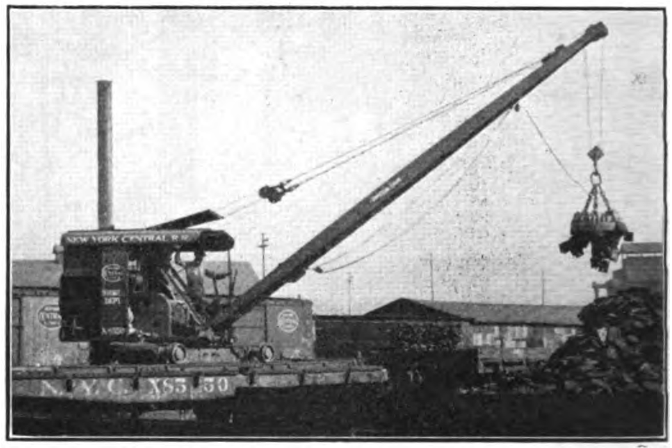
This device is similar in principle to the slide block type of drop lock formerly used on the same machine, but is an improvement over the old design, because of the extreme shortness of the lock, the increased engaging area and its smooth action. Its relatively light weight eliminates the counterweight and timing lock formerly employed.

A Crane for General Railroad Service

THE Universal Crane Company, Cleveland, Ohio, is manufacturing a light crane that is adapted to various types of mountings. The illustration shows a crane of the traveling type mounted on a standard flat car. The track on which the crane operates has a 6-ft. 6-in. gage and it may be easily extended from one car to another by laying additional sections. The crane can propel itself over a train of flat cars, as the material is handled. A mechanical locking device permits it to operate without fouling adjacent tracks while swinging. This crane may also be permanently mounted on the car and geared to the truck axle for work around shops where a locomotive is not required. The travel gear can be quickly disconnected.

The crane may be driven by either a four-cylinder heavy duty gasoline motor, or an electric motor. The use of either drive tends to reduce operating costs, as hostling is unnecessary, there is no time lost in getting up steam or taking water, there is no expense due to boiler maintenance and fuel is consumed only during actual operation. It is designed for one-man operation, and considerable attention has been paid in facilitating ease and rapidity of handling. All parts are made standard and interchangeable.

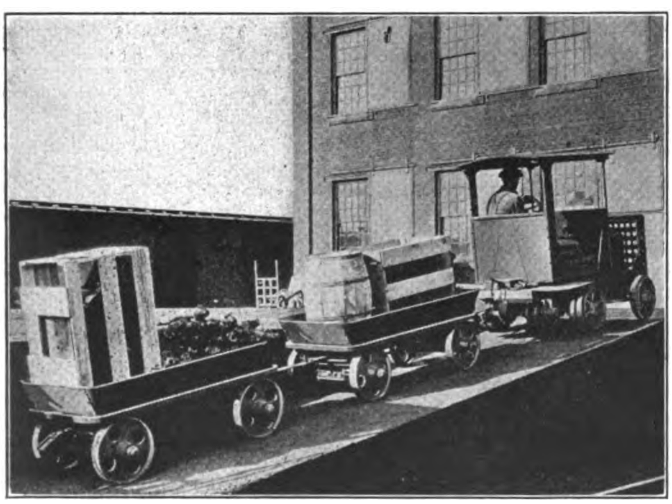
The ordinary equipment has a 28-ft. boom, so that the entire unit can be carried on one flat car. If specified, the crane can be built to handle a clam shell or drag line bucket. A generator to supply current for a magnet, hoist block, capstan head, niggerhead and various other types of equipment can be supplied if desired. On account of its light weight, this crane is adapted to special gage mountings on bins or trestles. It also has the added advantage of adaptability to motor trucks and trailers and can be easily transferred from one mounting to another.



Universal Crane That Can Be Adapted to Various Mountings

Gasoline-Driven Tractor for Railroad Use

A GASOLINE-DRIVEN tractor, built to stand the rough usage and service to which such a machine is generally subjected in the handling of freight, merchandise and baggage on warehouse, freight station and depot platforms, has been developed by the Omaha Steel Works, Omaha, Neb. This tractor is also well adapted to the transportation of materials, parts and tools in and about store rooms, back shops and enginehouses. The design and shape of the tractor platform can be varied to suit conditions, or a box body can be furnished when desired.



The Gasoline Tractor in Use

The power plant in the new tractor which is called the Omsteel is a Ford motor and transmission mounted on its own frame inside of and under the main frame of the tractor. This feature and the arrangement of axles and springs provides a double three-point suspension. A suitable pump is designed to assure positive water circulation. A Ford torque tube, drive shaft and rear axle are used for the drive, hardened, finished roller chains operating on cut steel sprockets, connecting the Ford driving unit and the rear wheels of the tractor. Radius rods provide for play of the springs and permit ample chain adjustment. A heavy, well braced steel plate and angle fender and bumper on the front of the tractor makes it possible to use the tractor for pushing as well as pulling.

The steel coupler is bell-mouthed and can be operated by the driver enabling him to couple or uncouple trailers from his position. The coupler is built for the standard Omsteel trailer equipment but can also be made to meet any required specifications.

In the trailer design the four wheels are mounted on steering knuckles connected to the drawbar so that the steering is accomplished by all four wheels. The wheels run on roller bearings, thereby greatly increasing the number of trailers which can be handled by one tractor. The trailers are relatively light in weight and can be shifted by hand.

GENERAL NEWS

The safety banner awarded annually by the Union Pacific to its shops showing the lowest accident record was awarded for 1923 to the shopmen at Denver, Colo., on March 13. Only 10 personal injuries occurred at these shops during 1923.

The shops of the Baltimore & Ohio at Parkersburg, W. Va., known as the "low yard" shops, have been abandoned, the high and low yard shops at that point having recently been merged at a contemplated saving of $40,000 a month. About 150 men have been laid off as a result of this consolidation.

The Chilean State Railways have recently published a list of materials needed for railway operation in 1924, on which bids are asked, according to Commerce Reports. The list includes a group of repair parts for locomotives, cars, and coaches, amounting to about 3,882,000 pesos (approximately $388,200 at current exchange).

Division officers from all divisions of the Chicago, Burlington & Quincy met at Omaha, Nebr., on March 20 to form committees for an economy campaign. Committees were formed for each division, each consisting of the division superintendent as chairman and division officers of the engineering, mechanical and stores departments as members.

The roundhouse of the Pennsylvania at Oil City, Pa., known as the North Side shops, was recently destroyed by fire. The building, a nine-stall, semi-circular frame structure, was burned to the ground. Ten locomotives, three of which were ready to be moved after receiving light repairs, were damaged to the extent of about $25,000. An investigation by Supt. J. J. Rhoades brought out the fact that a lighted torch left near a wooden locker in the south corner of the building was the cause of the fire.

The Reading Company has recently awarded a contract to the Baldwin Locomotive Works for the construction of five Pacific type locomotives similar to those now in use in New York service on its seashore and main lines. These locomotives will be built at Eddystone and will be delivered by June 1, 1924. When the locomotives will have been placed in service, the Reading Company will have 30 of this type in use over its lines. Each of the locomotives stands 15 ft. high on the rails and measures in length overall 79 ft. 6 in. The driving wheels are 6 ft. 8 in. in diameter. The weight of the engine and tender is 450,000 lb. and the tractive force is 40,900 lb.

Brotherhood Proposes to Get Rid of Labor Board

D. B. Robertson, president of the Brotherhood of Locomotive Firemen & Enginemen, has announced that the three Cleveland brotherhood presidents are supporting a bill to be introduced concurrently in the Senate and the House of Representatives at Washington, entitled "The Railway Labor Act," abolishing the United States Railroad Labor Board. The proposed act embodies some of the features of the present laws intended to preserve peace in the transportation industry, Mr. Robertson said. The basis of the bill is an obligation to negotiate agreements and to abide by such voluntary contracts.

Canadian Government Car Inspections

The number of cars inspected by the Dominion Board of Railway Commissioners in 1923 was 77,345, of which 3,458, or 4.47 per cent, were found defective. The grand total of defects was 3,811, of which 80 were in couplers and parts, 619 in uncoupling mechanism, 164 handholds and 2,007 air brakes.

Germany's Locomotive Exports Decrease

Exports of steam railway locomotives from Germany during the first nine months of 1923, according to Vice-Consul Magnuson at Stuttgart, were about 82 per cent less than in the corresponding period of 1922, locomotives decreasing from 1,321 with a weight of 64,768 metric tons to 482 with a weight of 11,928 tons; exports of tenders dropped from 846 to 109. The chief reason for this decline is the fact that Russia, which had been Germany's best customer in 1922, reduced its purchases from Germany in 1923 to a minimum. Rumanian imports of German locomotives also fell off considerably, as did those of all of the countries near Germany except East Poland.

Personnel of Bolt, Nut and Rivet Committee Appointed

The American Engineering Standards Committee has appointed a committee to develop standards for bolt, nut and rivet proportions. This work is being sponsored by the Society of Automotive Engineers and the American Society of Mechanical Engineers. This committee consists of 43 members, 17 of whom represent producers, 24 consumers, and 2 general interests. It is divided into eight sub-committees, dealing with the following specific subjects: large and small rivets, wrench head bolts and nuts, slotted head products, track bolts and nuts, carriage bolts, special bolts and nuts for agricultural machinery, body dimensions and material, and nomenclature.

Defective Locomotives in February

The number of locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during February was 5,631, according to the commission's monthly report to Congress on the condition of railroad equipment. Of these 3,064 were found defective and 577 were ordered out of service. The number of accidents caused by the failure of some part or

LOCOMOTIVE AND FREIGHT CAR REPAIR SITUATION

Date	Locomotives				
1923	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. repairs over 24 hr.	Per cent req. repairs over 24 hr.
January 1	64,453	48,905	576	13,587	21.1
April 1	64,559	50,107	914	12,801	19.8
July 1	63,906	52,456	2,181	10,326	16.2
October 1	63,982	54,159	2,620	8,787	13.7
November 1	64,192	54,080	2,517	9,163	14.3
December 1	64,336	53,764	3,367	9,577	14.9
1924					
January 1	64,406	54,031	5,061	9,395	14.6

Date	Freight cars				
1923	No. freight cars on line	Cars awaiting heavy repairs	Cars awaiting light repairs	Total cars awaiting repairs	Per cent of cars awaiting repairs
January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	2,270,405	116,697	38,929	155,626	6.8
1924					
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1
March 1	2,262,254	119,505	49,277	168,782	7.5

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5

appurtenance of the locomotive or tender was 92, in which 11 were killed and 99 injured. During the same month 87,965 freight cars were inspected, of which 3.8 per cent were found defective, and 1,481 passenger cars, of which 11 or .7 per cent were found defective. Fifteen cases involving 28 violations of the safety appliance acts were transmitted to various United States attorneys for prosecution.

Wage Statistics for December

The average number of employees of Class I railroads during the month of December, 1923, was 1,793,779, an increase of 5,189, or 0.3 per cent over the number reported for December, 1922, according to the monthly bulletin of wage statistics issued by the Interstate Commerce Commission. However, owing chiefly to the comparatively excessive overtime payments in December, 1922, there was a decrease in the total compensation of $13,010,507, or 5.3 per cent. The returns for December, 1923, compared with those for the preceding month, show a decrease in the number of employees of 105,766, or 5.6 per cent, which appears principally in the maintenance groups. Total compensation decreased $15,024,016, or 6.0 per cent.

A comparison of the cumulative returns for the twelve months, 1922 and 1923, shows an increase in 1923 of 14.3 per cent in employment, and of 14.0 per cent in total compensation.

Court Decisions

STRIKE NO DEFENSE TO CHARGES OF VIOLATING SAFETY APPLIANCE ACT.—The Circuit Court of Appeals, Ninth Circuit, holds that an emergency caused by a strike is no defense to a charge of violation of the federal Safety Appliance Act. A railroad which receives a car in a defective condition from another carrier is forbidden to haul it over its lines any distance, for any purpose, unless it is a mere incidental movement, to reach other cars on the exchange track. Where the evidence as to defect in the car conflicted, the question of existence of the defect was held for the jury.—United States v. Northern Pacific, 293 Pac. 657.

SECOND ACTION FOR VIOLATION OF BOILER INSPECTION ACT BARRED.—The Circuit Court of Appeals, Ninth Circuit, holds that a judgment for the railroad in an action for personal injury due to its alleged failure to comply with the regulations adopted under the Boiler Inspection Act in a specified respect (that the cab apron was not roughened and was not level with the tender floor), is a bar to a subsequent action for the same injury, where failure to comply with a different requirement of the regulations (that the apron was too short at each end, making the gangway between locomotive and tender insufficient in width) was alleged to have caused the injury.—Miller v. Spokane International, 293 Fed. 748.

Wages

The shop crafts employees on the Southern Railway have filed with the management of the road a request for wage increases. The increase asked is four cents an hour.

The railway employees' department of the American Federation of Labor is about to demand wage increases of 4 cents an hour for the shopmen it represents, according to a report from Chicago. The fact that the shopmen have asked such an increase on the Southern and the Mobile & Ohio is considered as an indication of a concerted drive for general increases.

LOCOMOTIVES INSTALLED AND RETIRED

Month 1923	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
Sept. ...	384	22,342,517	260	7,191,302	64,720	2,506,469,051
Oct. ...	408	21,665,487	301	7,935,709	64,827	2,520,200,846
Nov. ...	333	19,054,713	282	7,741,395	64,879	2,532,085,380
Dec. ...	333	18,260,423	316	8,738,378	64,896	2,541,607,425
1924						
Jan. ...	271	15,228,895	178	4,447,721	64,989	2,552,694,953
Feb. ...	214	....	175	....	65,029	....
March .	...	....	...	....	.....	....

Figures prepared by Car Service Division, A. R. A., published prior to October in reports relative to progress, made on A. R. A. transportation program, and more recently in greater detail given in form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Employees in the shops of the American Locomotive Company at Dunkirk, N. Y., have accepted a reduction in wages of about 10 per cent, the request of the company having been made on the basis of the argument that without such a reduction certain orders for work could not be secured. As the result of the agreement these shops are to build 25 locomotives for the Union Pacific and 24 for the Louisville & Nashville. The shopmen have requested local merchants and physicians to reduce their prices to correspond with the prospective reduction in the incomes of the petitioners.

Negotiations for the upward revision of wage schedules to the 1920 level have been reopened between a committee representing the station, shop, shed, roundhouse, clerical and other employees and a committee representing the management of the Canadian National Railways. The average increase over the present wages sought by the men is 12½ per cent. Negotiations are being conducted in Montreal. Notice was given last summer by the employees that they desired a revision of the wage schedule and of working conditions and their committee met a committee of the C. N. R. management, under A. E. Crilly, chief of the wage bureau. Activities were suspended pending the convention of the Canadian Brotherhood of Railway Employees.

General Electric Company to Run Important Tests

Operating officials from a number of important steam railroad systems are co-operating with the General Electric Company in conducting operating tests with locomotives to determine the limits of adhesion during acceleration and running with various train weights and different conditions of rail.

The otheograph, demonstrated last December at the Erie Works of the General Electric Company, will play an important part in the tests.

The equipment used will be a Mikado type freight locomotive No. 74, furnished by the New York Central Railroad; one of the new Mexican locomotives, recently completed at the Erie works of the General Electric, and a G-E experimental locomotive No. 18.

The trailing train used with the above locomotives in turn will be made up of a dynometer car, 10 loaded coal cars and a coach giving a total weight of approximately 1,000 tons.

Another train will consist of the dynometer car, five coal cars and a coach, approximately 600 tons.

The tests will be repeated on a dry rail, a dry rail sanded, wet rail, and wet rail sanded.

MEETINGS AND CONVENTIONS

The Chief Interchange Car Inspectors' and Car Foremen's Association will hold its next regular annual meeting at the Sherman hotel, Chicago, on September 16, 17 and 18.

Pacific Railway Club Elects Officers

At its seventh annual meeting held at the Hotel Oakland, Oakland, Cal., March 13, 1924, the Pacific Railway Club elected the following officers to serve during the coming year: President, H. A. Mitchell, vice-president and general manager of the San Francisco-Sacramento Railroad; first vice-president, J. W. Williams, chief engineer, Western Pacific; second vice-president, A. S. McKelligon, general storekeeper, Southern Pacific; treasurer, R. G. Harmon, chief clerk, Denver & Rio Grande-Western Pacific; secretary, William S. Wollner, general safety agent, Northwestern Pacific.

Cleveland Steam Railway Club

The car men of Cleveland, Ohio, and vicinity have organized the Cleveland Steam Railway Club, with meetings to be held the first Monday of each month at the Hotel Cleveland, Public Square, Cleveland. The officers of the club are as follows: President, T. O. Quinn, general car foreman, Big Four, Cleveland; first vice-president, L. J. Collins, general foreman, New York Central, Nottingham, Ohio; second vice-president, G. L. Foster, assistant chief joint inspector, Cleveland; secretary-treasurer, F. L. Ferricks, car foreman, New York Central, Cleveland. Executive committee: T. J. Bell, car foreman, Erie Railroad, Cleveland; G. L. Staley, steel car foreman, Big Four, Cleveland; H. E. Kirkwood, car foreman, Baltimore & Ohio, Cleveland. The club was

organized for the purpose of discussing subjects of interest to car department employees. It is the intention to invite prominent railway officials to address the club on some live subject at each meeting. 285 members are enrolled. At the first regular meeting on Monday evening, March 3, at which 182 members were present, E. A. Jackson, supervisor of inspectors of the Big Four at Indianapolis, Ind., presented a paper on the preparation of record repair cards, and writing and checking repair bills.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 2-5.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que., Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting April 8. A paper on Handling of Mail will be read by V. Gandet, postmaster, City of Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y. Next meeting April 10. Papers on Handling L. C. L. Freight and Joint Inspection of the Trunk Line Freight Inspection Bureau of Buffalo, will be read by George A. Bax, local freight agent, and John C. Smith, district manager, New York Central, respectively.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 16, 17 and 18.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Ferricks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23. Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting April 8. A paper on The Passenger Car Up-To-Date will be read by C. E. Barba, superintendent, Osgood Bradley Car Company. Annual banquet and entertainment May 13-24.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Tuesday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting April 11. Illustrated lecture on The Steel Industry, by R. J. Kaylor, publicity manager, Youngstown Steel & Tube Company.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1924.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August. Next meeting April 21. A paper on Serviceability Economics of 100 Per Cent Locomotives, will be read by C. A. Seley.

SUPPLY TRADE NOTES

Benjamin M. Carr, sales agent of the Pullman Company, died on March 22 at Houston, Texas.

Frederic E. Wright has joined the sales department of the International Oxygen Company, Newark, N. J.

The Chicago Pneumatic Tool Company will construct a three-story, 45 ft. by 126 ft. extension to its plant at Cleveland, Ohio.

Leroy Beardsley, treasurer of the Chicago Pneumatic Tool Company from 1898 to 1918, died on March 5, at Riverside, Ill.

The Pittsburgh, Pa., office of the Niles-Bement-Pond Company has been removed from 425 Seventh avenue to 503 Liberty avenue.

John W. Shoop, office manager of the Lehon Company, Chicago, has been promoted to manager of railway sales, with headquarters at Chicago.

J. L. Phillips, manager of the Atlantic office of the Okonite Company, has been transferred to San Francisco as manager of the San Francisco office.

E. D. Allmendinger, manager of the foreign department of the Black & Decker Manufacturing Company, Towson, Md., sailed for England recently in the interest of his company.

Arthur P. Skaer, assistant chief engineer of the Corrugated Bar Company, has been appointed district manager of the Kalman Steel Company, with headquarters at Buffalo, N. Y.

Herbert Mertz, secretary and sales manager of the Orton-Steinbrenner Company, with headquarters at Chicago, has been elected a director, succeeding H. G. Steinbrenner, resigned.

L. Sparks, New England manager of the Erie Steam Shovel Company, has been appointed eastern sales manager of the Ohio Locomotive Crane Company, with headquarters at New York.

Howard W. Evans, vice-president and general manager of George B. Limbert & Co., Chicago, has been appointed executive vice-president and sales manager of Warren Corning & Co., Chicago.

F. E. Finley, formerly manager railway sales, Laclede Steel Company, has become associated with the Kansas City Bolt & Nut Company, as district sales agent, with headquarters at St. Louis, Mo.

The Pawling & Harnischfeger Company, Milwaukee, has purchased from the receivers the entire property of the Hercules Steel Castings Company, Milwaukee, and will operate the plant about May 1.

C. E. Eklind, chief draftsman in the office of the engineer of car construction of the Atchison, Topeka & Santa Fe, has been appointed mechanical engineer of the Camel Company, with headquarters at Chicago.

The Clark Car Company, Pittsburgh, Pa., has removed its New York City office from the Woolworth building to 52 Vanderbilt avenue, suite 803. B. K. Mould, eastern manager, is in charge of this office.

The Bulldog Automatic Coupler Company, Pikesville, Ky., has been incorporated with the following officers: A. J. Baldwin, president; Charles D. Jacobs, vice-president, and A. L. Nunnery, secretary and treasurer.

C. J. Priebe has recently joined the sales organization of the Keller Mechanical Engineering Corporation, Brooklyn, N. Y. Mr. Priebe was previously engaged in editorial and advertising work for the American Machinist.

The Baldwin Locomotive Works has begun the gradual removal of its entire Philadelphia shops to Eddystone, Pa. The estimated cost of this work, which is being done under the direction of Samuel M. Vauclain, is $16,000,000.

The Landis Machine Company, Waynesboro, Pa., has adopted the name "Land-Matic" for its line of automatic die heads for turret lathes and hand-operated screw machines. In the future, this product will be known as the Land-Matic die heads.

The Morton Manufacturing Company, Chicago, has appointed the Consolidated Equipment Company as its representative for the sale of Acme Line of Railway Appliances for the Dominion of Canada with headquarters at 260 St. James street, Montreal, Que.

The Cleveland office of the Simmons-Boardman Publishing Company, publishers of the *Railway Mechanical Engineer* and other railroad and marine papers, has been moved from 4300 Euclid avenue to more commodious quarters at 6007 Euclid avenue.

The Ward Railway Equipment Company, Lima, Ohio, has been incorporated for $50,000, to manufacture miscellaneous equipment for railroads. The incorporators are O. G. Snyder, Edward P. Kirly, George T. Shanbow, B. E. Parish, J. T. Ward, Charles Ershick and J. B. Rowntree.

The American Railway Car Company, Portland, Ore., is preparing to erect a factory at Tigard, Ore., for the manufacture of Bowen gasoline railway cars. Officers of the company are A. B. Bowen, president; A. C. Forrester, vice-president, and Macdonald Potts, secretary-treasurer.

John M. Mack, inventor of the Mack truck and founder of the Mack Motorcar Company, which later became the International Motor Company, was killed March 14 near Neffs, Pa., when a work car of the Lehigh Valley Transit Company crashed into the automobile he was driving.

The Dixon Waste Company, with office and works at Manayunk, Philadelphia, Pa., will in future assume deliveries of all regular products of the Trumbull Waste Manufacturing Company of Manayunk. The latter company on March 5 discontinued active business and is now liquidating its affairs.

The Galion Iron Works & Mfg. Company, Galion, Ohio, is organizing a railroad sales department. The St. Louis office, handling the central and western territory, has been placed in charge of Taylor D. Kelley and Harvey DeCamp. The company will specialize on 25, 50 and 100-ton coal tipples and railroad cinder hoists.

Joseph W. Irwin has resigned as superintendent of the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa., to take the position of vice-president and general superintendent of the Mitchell Spring & Manufacturing Company, Inc., Johnstown, Pa. Mr. Irwin has had a long operating experience in the manufacture of railroad, electric traction and industrial springs, having been with the Fort Pitt Spring & Manufacturing Company for the past 12 years. He formerly served for a period of 25 years with the A. French Springs Works, which later became the Railway Steel Spring Company, having begun his service with that company as one of the shopmen and working up to the position of assistant superintendent.

J. W. Irwin

The Heim Grinder Company, Danbury, Conn., was organized on March 1, having acquired the entire interest of The Ball & Roller Bearing Company in the Heim centerless grinder. The following were elected officers of the company: Henry N. Flynt, president; Clayton O. Smith, vice-president, and Ferris M. Angevin, secretary and treasurer.

The Graver Corporation has moved its railroad office from 1412 Steger building, Chicago, to the main office and works of the company at East Chicago, Ind., and will retain its office in Chicago as a branch sales office. J. J. Felsecker, manager of water softening sales, will have charge of the railroad department, succeeding W. R. Toppan, resigned.

C. H. Pridey, salesman of S. F. Bowser & Co., with headquarters at St. Louis, Mo., has been promoted to superintendent of the Kansas City district with headquarters at Kansas City. D. S. Price, an engineer, has been promoted to district manager in charge of the lubrication and filtration department, with headquarters at Detroit, Mich. O. M. Tottom, engineer, has been promoted to district manager in charge of the lubrication and filtration department, with headquarters at Indianapolis, Ind.

The Tennant Company, Union National Bank Building, Houston, Texas, now represents the Heine Boiler Company, St. Louis, Mo., in a new territorial division comprising the entire southern half of the state of Texas. J. A. Tennant is in charge of this office. Smith & Whitney, Dallas, Texas, will continue as representative of the Heine Boiler Company in the northern half of Texas.

Fred A. Meckert has resigned as general manager of the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa., to become president and general manager of the Mitchell Spring & Manufacturing Company, Inc., of Johnstown, Pa. This company was incorporated recently with a capital stock of $350,000. Mr. Meckert has been with the Fort Pitt Spring & Manufacturing Company since March 1, 1919, having gone to that company from the Standard Steel Works Company, Philadelphia, Pa., where he served for 14 years and in charge of the spring department as manager and spring designer. Before entering the service of the Standard Steel Works Company, Mr. Meckert was employed for three years as private secretary of Albert Ladd Colby, who at that time was assistant to president of the International Nickel Company, in New York City.

F. A. Meckert

J. J. Edwards, vice-president of the O. M. Edwards Company, Syracuse, N. Y., has established his headquarters at the Chicago office of the company, First National Bank Building, where in conjunction with C. H. Rockwell, western manager, he will give special attention to the varied interests of that company. Mr. Edwards expects to be located in Chicago for about two years.

Stuart J. Dewey, formerly assistant signal engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, and more recently engineer with the State Highway Commission of Pennsylvania, has been appointed sales engineer of the Truscon Steel Company, with headquarters at New York. The Truscon Steel Company has leased a building at Erie and St. Clair streets, Chicago, to which it will move its Chicago offices on May 1.

H. S. Brautigam, assistant to the master car builder of the Chicago, Milwaukee & St. Paul, has resigned to become a representative of the railroad department of the Allegheny Steel Company, Brackenridge, Pa. Mr. Brautigam has served for about thirteen years in the car department of the Chicago, Milwaukee & St. Paul in various capacities, consecutively as clerk, car inspector, chief clerk, assistant car foreman, general safety appliance inspector and assistant to the master car builder.

Elijah Bates, local manager of Haskins & Sells, public accountants, with headquarters at Cleveland, Ohio, has been appointed secretary and treasurer of the McMyler-Interstate Company, with headquarters at Cleveland, Ohio, succeeding H. H. Hammond, resigned. The Chicago office of the McMyler-Interstate Company has been moved to 648 Railway Exchange building, and a new branch office has been opened at 619 Genesee building, Buffalo, N. Y., in charge of J. E. McFate, Buffalo district representative.

The Davis Boring Tool Company, St. Louis, Mo., is erecting a fireproof factory building 182 feet long and 75 feet front, that will cost approximately $130,000. It is of modern construction throughout and is to be one of four similar units to be constructed

on land owned by the company. This building will be approximately two and one-half times larger than the present factory and, with the new equipment that the company expects to install, it is calculated that the production of the plant will be increased about five times.

N. B. Norris, district manager at New Orleans, La., of the Pawling & Harnischfeger Company, Milwaukee, Wis., has been appointed district manager of the Memphis, Tenn., office. D. J. Murphy of the New Orleans office has been appointed district manager of the Texas district, with headquarters at Dallas, Texas. F. W. Truex will continue as district manager at Atlanta, Ga., with office at 212 Haas-Howell building and W. J. Dugan as southern sales manager will assume charge of the entire southern territory, with headquarters at Memphis.

Frederick V. Green was elected second vice-president of the Pittsburgh Testing Laboratory, Pittsburgh, Pa., at the February meeting of the board of directors. His headquarters will be at the New York office of the company, 50 Church street and he will have direct charge of the eastern district. Mr. Green was born in New York City and received his education at Nyack, N. Y. After serving in the lumber business he organized in 1895 the Empire Engine & Motor Company, and was its treasurer until 1902, when he became associated with the Westinghouse Air Brake Company as assistant general sales manager in the New York territory. From 1919 he served for about four years as sales manager of the Baldwin Locomotive Works, at Johannesburg, South Africa. Since September, 1923, he has been with the Pittsburgh Testing Laboratory as assistant to the president.

F. V. Green

The Colorado Central Railways Company, Denver, Colo., has been incorporated under the laws of Colorado for the purpose of manufacturing steam and electric railway cars and other railway equipment. It will operate in conjunction with the American Railway Steel Corporation and the Missouri Car Company, East St. Louis, Ill. The company has taken over the plant formerly used by the Denver Paper Company. Orrin Merry, president of the Missouri Car Company, is president of the Colorado Central Railways Company and M. L. Phelps is consulting engineer.

Charles N. Winter, managing editor of the Locomotive Cyclopedia and the Car Builders' Cyclopedia and formerly associate editor of the *Railway Mechanical Engineer,* has resigned to become general manager of the Rogatchoff Company of Baltimore, Md. Mr. Winter's headquarters will be at 90 West Broadway, New York, and in the Koehler building, Ridgewood, N. J. His new duties will include the direction of sales and advertising of the Rogatchoff Company in the United States, Canada, Great Britain and Australia.

R. C. Shaal, president of the R. C. S. Equipment Company, New York City, formerly vice-president of the Safety Car Heating & Lighting Company in charge of electrical department, New York, and long associated with the sales department of the Pyle National Company as vice-president in charge of sales and maintenance for territory east of Chicago, and other railway supply companies, is now associated with the Standard Stoker Company, Inc., at New York, in special sales work. Mr. Shaal will continue as president of the R. C. Shaal Company and retain the relations which he holds in other companies.

H. D. Megary, managing director of the Consolidated Pneumatic Tool Company, London, England, died on March 20. Mr. Megary was born in Philadelphia on April 21, 1888, and graduated from the University of Pennsylvania in 1909. Following his graduation he became affiliated with the Bethlehem Steel Company, remaining with that company until June, 1918, when he went to the Chicago Pneumatic Tool Company as assistant to the president, later being made secretary of the company. In 1921 he was transferred to London to assume the duties of managing director of the English company. He was also director of European sales.

William R. Hillary has been appointed sales engineer with headquarters at the home office of the National Lock Washer Company, Newark, N. J. Mr. Hillary is an engineer of wide railroad experience, having started his career with the Pennsylvania Railroad System, as assistant on the engineering corps in the Cincinnati division, immediately upon his graduation from the University of Pennsylvania, in 1897, where he received the degree of civil engineer. He subsequently held many important positions, having served consecutively as assistant supervisor, assistant division engineer, division engineer and engineer of maintenance of way, at Toledo, Ohio.

George Frank Konald, general manager and treasurer of the Warren Tool and Forge Company, Warren, Ohio, died in a hospital in that city on March 3, from complications following an operation. He was born at East Douglas, Mass., on June 25, 1864, and at the age of 15 entered the employ of the Iron City Tool Works as a hammerman's helper, later becoming a hammerman. He was employed in various positions in this plant for the following nine years, when, at the age of 24, he succeeded his father as superintendent of this plant. He held this position until December, 1911, when he became associated with the Warren Tool & Forge Company, which had been organized by his brother, M. J. Konald and J. D. Robertson, and continued his connection with that company until his death.

H. C. Oviatt, formerly general mechanical superintendent of the New York, New Haven & Hartford, is now associated with the Standard Stoker Company, Inc., as assistant to the president, with headquarters in the Grand Central Terminal, New York City. Mr Oviatt has had many years' railroad experience in both mechanical and transportation departments, having entered the service of the New York, New Haven & Hartford in 1889 as locomotive fireman. He later was promoted to locomotive engineman and subsequently served successively as air brake inspector, master mechanic and assistant mechanical superintendent. He then entered the transportation department as division superintendent and later was promoted to general superintendent. During the war he went with the American International Shipbuilding Corporation at Hog Island and organized and operated the transportation department in connection with the building of ships for the government. He returned to the New York, New Haven & Hartford in 1918 as superintendent of the Central New England and in a few months was made superintendent of motive power of the New Haven, and later general mechanical superintendent. At the time he left railroad work, Mr. Oviatt was a member of the General Committee, the Committee on Locomotive Design and Construction, Div. V, Mechanical, of the A. R. A.

H. C. Oviatt

The Wayne Tank & Pump Company, Ft. Wayne, Ind., has established an organization among the sales representatives of its water softening division, to be known as the Wayne H-2-O Club. Salesmen who have reached their sales quota are eligible for membership. The purpose of the club is to foster better salesmanship in the marketing of the company's products, to create a feeling of friendly rivalry between salesmen and the various district offices and to promote better understanding and co-operation between the field and office forces of the water softening division. Officers of the club will be selected on the basis of the volume of business during the year. The ten members of the board of directors will be those having the next highest volume of business handled. Each representative qualifying

for membership in the club will be presented with a gold emblem and a diamond will be mounted on the emblem for each successive year. Special awards will also be given annually for high volumes of business.

Fred A. Hansen was appointed district manager for the Electric Heating Apparatus Company in the Chicago territory, effective with the recent termination of a sales agreement of this company with the Westinghouse Electric & Manufacturing Company. Mr. Hansen attended Northwestern University, Chicago, and the University of North Dakota and first entered railway service in 1913 on the Atchison, Topeka & Santa Fe in the track department. In 1914 he left the Santa Fe to enter the signal department of the Chicago, Rock Island & Pacific and later served the American Bell Telephone Company until he entered the army during the late war. Mr. Hansen served about a year in France in the engineering corps of the army, and after the armistice he had charge of the electrical construction work at the Savenay Base Hospital center in France. Upon his return to the United States he entered the employ of the Westinghouse Electric & Manufacturing Company as industrial heating engineer, handling electric furnaces and other industrial electrical heating matters. On September 1, 1923, the sales agreement between the Electric Heating Apparatus Company, Newark, N. J., and the Westinghouse Electric & Manufacturing Company was terminated, and Mr. Hansen was appointed district manager, with headquarters in Chicago.

Charles W. T. Stuart has resigned as foreman of car lighting of the Pennsylvania Railroad to become representative in the Philadelphia office of the Safety Car Heating & Lighting Company. Mr. Stuart was born in Philadelphia in 1888 and, after studying at the Engineering School of the Drexel Institute, entered the car lighting department of the Pennsylvania Railroad in 1909. At that time there were but a few electric lighted cars. Mr. Stuart has made a specialty of this particular branch of railway equipment ever since he became connected with the railroad. He has contributed largely to railway publications on car lighting subjects, including a series of articles in the Railway Electrical Engineer on the fundamental principles of car lighting. His largest contribution to car lighting literature is his recent book "Car Lighting by Electricity," which is the first complete volume covering this subject.

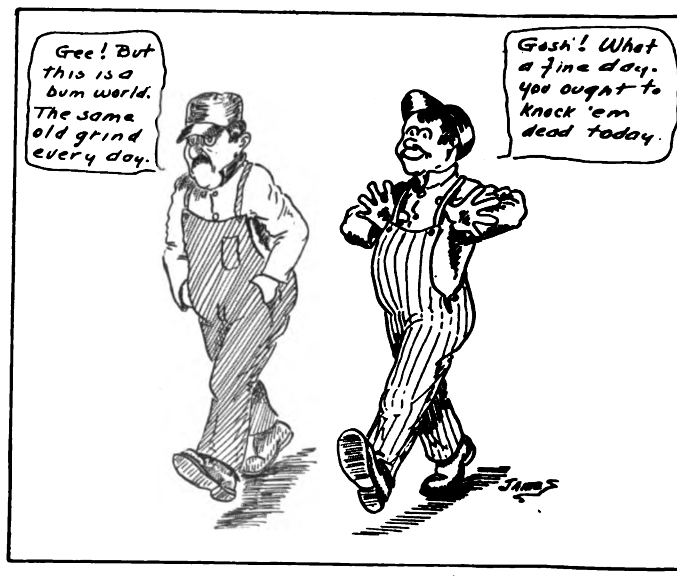
C. W. T. Stuart

Tom G. Windes, manager of the railroad department of the International Filter Company, Chicago, has resigned to become general sales manager of the recently organized Aluminate Sales Corporation, Union Stock Yards, Chicago, distributors of aluminate of sodium now being manufactured on a commercial scale for use in water softening. He was born on April 26, 1879, in Chicago and studied chemical engineering at the University of Wisconsin, graduating in 1902. He then entered the employ of the Pfister & Vogel Leather Company, Milwaukee, as a chemist, which position he held until the following year, when he entered the metallurgical laboratories of the Illinois Steel Company, Chicago. Later he was employed as a chemist in the Griffin Car Wheel Works until 1905 when he became associated with the Kennicott Water Softening Company, Chicago. He entered railway service the following year as a chemist in charge of water softening on the Vandalia (now the St. Louis division of the Pennsylvania), where he remained until 1909, when he returned to the reorganized Kennicott Company as manager of the railroad department. In 1916 he became Chicago representative of the L. M. Booth Company, New York, and after the absorption of this company by the Refinite Company, Omaha, Neb., in 1920, continued in the same capacity with the latter organization until July, 1921, when he re-entered the employ of the International Filter Company, Chicago, as manager of the railroad department.

T. F. Manville, president and treasurer of Johns-Manville, Inc., New York, was elected chairman of both the board and the executive committee at a recent meeting of the board of directors; H. E. Manville, vice-president and secretary, has been elected president; L. R. Hoff, general sales manager at New York, has been elected vice-president and general manager of the company; W. R. Seigle has been re-elected vice-president and general manager of the factories and mines; J. E. Meek, general manager of the railroad and United States Government department, and J. W. Perry, general manager of the electrical department; also J. S. Carroll, general manager of the oil industry department have been elected vice-presidents; A. C. Hoyt, assistant treasurer, has been elected secretary and treasurer, and T. F. Manville, Jr., has been appointed assistant secretary, all with headquarters at New York. The members of the newly elected executive committee are T. F. Manville, H. E. Manville, L. R. Hoff and W. R. Seigle. Mr. Meek was born at State College, Pa. He served seven years with the Pennsylvania Railroad at Altoona, Pa., shops, later going to Denver, Colo., in 1888, remaining there for six years, the last three years of which he was chief engineer of power plant. He entered the employ of the H. W. Johns Company, New York City, in 1894, and went with the new organization of the H. W. Johns-Manville Company in 1902, and formed the railroad and United States government departments of this company in 1906, and has held the position of general manager of same up until his present promotion. He still retains direct supervision of these departments in addition to other duties. He is also a director of the corporation.

Pratt & Lambert, Inc., Elects New Officers

At a recent meeting of the board of directors of Pratt & Lambert, Inc., Buffalo, N. Y., A. D. Graves was elected senior vice-president and treasurer; J. B. Bouck, Jr., was elected vice-president in charge of the eastern division at New York City and F. W. Robinson was elected vice-president in charge of manufacturing. The following officers were re-elected: J. H. McNulty, president; J. N. Welter, vice-president in charge of the western division; H. E. Webster, secretary. A. D. Graves entered the service of Pratt & Lambert, Inc., in 1908 as a salesman; ten years later he became manager of trade sales. In January, 1921, he was promoted to general manager and now becomes senior vice-president and treasurer. J. B. Bouck, Jr., began service with Pratt & Lambert, Inc., in 1893 as office boy. He subsequently served successively as salesman, assistant resident manager and resident manager. In 1917 he was appointed secretary-treasurer of the company and has now been elected vice-president in charge of the eastern division, with headquarters at New York City. F. W. Robinson began work with Pratt & Lambert, Inc., at its New York plant in 1896, he subsequently served as general superintendent and now becomes vice-president in charge of manufacturing.



Let Good Humor Be a Habit, Nobody Ever Heard of a Grouch Getting Anything But the Gate

TRADE PUBLICATIONS

Belting.—"Quality Facts About Belting" is the title of a series of helpful suggestions on belt buying, which is being issued by the Chas. A. Schieren Company, New York.

Wires and Cables.—Both railroad and power installations of Okonite wires and cables are shown in an illustrated booklet recently issued by the Okonite Company, Passaic, N. J.

Industrial Furnaces.—Stewart furnaces, capable of handling any class of work in heat treating, are described in an illustrated folder recently issued by the Chicago Flexible Shaft Company, Chicago.

Grinding Machines.—A general description of the Gisholt internal and link grinder for railroad work, also a description of the link grinding attachment, is contained in a four-page folder issued by the Gisholt Machine Company, Madison, Wis.

Flexible Metal Hose.—The American Metal Hose Company, Waterbury, Conn., has issued a 24-page brochure descriptive of its flexible metal hose, which is especially adapted for conveying steam and oils and for numerous other special purposes.

Standardization.—The American Engineering Standards Committee, New York, has just issued an interesting booklet entitled, "Standardization—what it is doing for industry." This describes how standardization is being carried on; first, in the individual plant; second, in industry as a whole; third, nationally on an inter-industrial basis, and, fourth, internationally.

Power Pipe Machine.—The "Willie Williams," a new portable pipe threading, cutting-off and reaming machine, is fully described and illustrated in a catalogue recently prepared by the Williams Tool Corporation, Erie, Pa. The machine is demountable, has a wide threading, cutting-off and reaming capacity, and has a handy self-contained grinder and three drives—motor, belt and hand.

Saws and Tools.—Catalogue E, illustrating and describing a complete line of solid and inserted tooth metal cutting circular saw blades, inserted tooth setting device, serrating device for friction disks, slate saws, pipe cutters, circular knives, rotary shear blades, saw sharpening machines, pneumatic hammer rivet sets and chisel blanks and hardened steel specialties, has recently been issued by the Hunter Saw & Machine Company, Pittsburgh, Pa.

Twin-Span Turntable.—Catalogue TS, containing a complete description and specifications for Bethlehem twin-span turntables, also a number of full page illustrations showing typical installations, has recently been issued by the Bethlehem Steel Company, Bethlehem, Pa. The twin-span turntable is of a non-balanced type. This feature eliminates the necessity of balancing the table when turning an engine, thus giving it a greater capacity than the balanced type table of equal length.

Specifications for Lubricants.—Technical Paper 323-A, "United States Government specification for lubricants and liquid fuels and methods for testing," has just been issued by the Department of the Interior, through the Bureau of Mines, Washington, D. C. This specification, known as standard specification No. 2c, is a revision of the specification officially adopted by the Federal Specifications Board on February 3, 1922, for the use of the departments and independent establishments of the government in the purchase of materials covered by it. It becomes mandatory June 18, 1924.

Screw Cutting Tools and Machines.—An attractive 204-page illustrated catalogue of screw cutting tools and machines has recently been issued by the Geometric Tool Company, New Haven, Conn. The catalogue is divided into six parts. Part I outlines the specialized and standardized Geometric screw cutting tools, the field and range of utility and adaptability, etc. The basic principles and the different styles of self-opening and adjustable die heads are described in Part II. Instructions for operating and ordering are also given in this section. Part III is devoted to adjustable and collapsing taps. Parts IV and V cover chaser grinders and threading machines. "Standard Threads" is the title of Part VI, in which interesting comparisons of diameters and pitches of A. S. M. E., S. A. E., Metric standard, International and French standard, British standard threads, etc., are given.

PERSONAL MENTION

General

W. H. Fetner, assistant to the president of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to chief mechanical officer, with the same headquarters, a newly created position.

Master Mechanics and Road Foremen

G. H. Langton, formerly mechanical inspector of the Chesapeake & Ohio, has been appointed general master mechanic of the Eastern General division, with headquarters at Clifton Forge, Va.

H. K. LeSure, chief electrician in the office of the general superintendent of motive power of the Eastern Region of the Pennsylvania, has been appointed master mechanic of the New York Terminal.

W. A. BeDell, general master mechanic of the Missouri Pacific at St. Louis, Mo., has been assigned to the Lines West and St. Louis Terminal division west of the Mississippi river, excepting the Sedalia back shop.

W. R. Kennedy, assistant master mechanic in charge of the rebuilding of locomotives at the Montreal Locomotive Works, has been appointed to fill the newly created position of assistant master mechanic of the Wabash, with headquarters at Peru, Ind.

Ross H. Hale, whose appointment as master mechanic of the Alaska Railroad at Anchorage, Alaska, was announced in the March issue of the *Railway Mechanical Engineer*, was born on April 28, 1896, at Eau Claire, Wis. He received a grammar and technical school education, and from 1913 to 1917 was in the employ of the Southern Pacific as a machinist apprentice and machinist. In 1918 he became marine machinist and insulation foreman of the Patterson McDonald Shipyards at Seattle, Wash. He then successively served as a machinist on the Los Angeles & Salt Lake at Los Angeles, Cal.; mechanical inspector at Salt Lake City, Utah; erecting foreman at Provo, Utah; roundhouse foreman at Lynndyl, Utah; district foreman at Caliente, Nev.; roundhouse foreman at Los Angeles, and general foreman at Kelso, Cal.

R. H. Hale

D. W. Cunningham, general master mechanic of the Missouri Pacific, with headquarters at Little Rock, Ark., has been assigned to the Lines South, St. Louis Terminal east of the Mississippi river, Illinois division and North Little Rock and Sedalia back shops.

M. J. Dunnebacke has been appointed master mechanic of the Duluth, South Shore & Atlantic, succeeding J. Herron, superintendent of motive power and machinery, who has resigned. The office of superintendent of motive power and machinery has been abolished.

Car Department

H. A. Sigwart, traveling mechanical inspector of the Illinois Central, with headquarters at Memphis, Tenn., has been appointed supervisor of car repairs for the Missouri Pacific, with headquarters at St. Louis, Mo.

Shop and Enginehouse

Albert L. Hafner has been promoted to assistant shop foreman of the Mt. Clare shops of the Baltimore & Ohio at Baltimore, Md.

A. W. Fisher has been appointed superintendent of shops of the Baltimore & Ohio at Sandusky, Ohio, succeeding F. J. Cheshire.

Arley Hay, machinist, has been appointed assistant roundhouse foreman of the Kansas City Southern, with headquarters at Pittsburg, Kans.

F. J. Cheshire, superintendent of shops of the Baltimore & Ohio, with headquarters at Sandusky, Ohio, has been transferred to South Chicago, Ill.

T. L. Mallam, foreman of the Trenton boiler shop of the Pennsylvania, has been appointed foreman of the Juniata boiler shop at Altoona, Pa., succeeding T. J. McKerihan.

A. F. Stiglmeier has resigned as general boiler foreman of the Mt. Clare shops of the Baltimore & Ohio to accept a like position with the New York Central at West Albany, N. Y.

J. W. Lemon, master mechanic on the Missouri Pacific, with headquarters at Hoisington, Kans., has been promoted to superintendent of shops at Sedalia, Mo., succeeding J. P. Brown.

B. H. Werbel, formerly machine shop erecting foreman of the Chicago Great Western at Oelwein, Ia., has been appointed general roundhouse foreman, with the same headquarters, succeeding George Hain.

George Hain, formerly general roundhouse foreman of the Chicago Great Western at Oelwein, Ia., has been appointed acting shop superintendent, with the same headquarters, succeeding A. B. Clark, deceased.

E. R. Larson, general foreman, motive power department of the Delaware, Lackawanna & Western, with headquarters at Kingsland, N. J., has been appointed shop superintendent of the Bellmead shops of the Missouri-Kansas-Texas, with headquarters at Waco, Tex.

H. M. Warden has been promoted to superintendent of the locomotive department of the Missouri-Kansas-Texas, with headquarters at Parsons, Kans. Mr. Warden was born on January 12, 1887, at San Antonio, Tex. He entered railway service as a machinist apprentice on the San Antonio & Aransas Pass and in August, 1914, was appointed machinist on the Missouri-Kansas-Texas. He was promoted to roundhouse foreman in December, 1914, and in May, 1915, he was promoted to general foreman at Wichita Falls, Tex. Mr. Warden was transferred to Smithville, Tex., in August, 1916, and was promoted to superintendent of the reclamation plant at Parsons, Kans., in October, 1918. He held this position until December, 1923, when he was promoted to shop superintendent at Waco, Tex. Mr. Walden held this position until his promotion to superintendent of the locomotive department, with headquarters at Parsons, Kans.

H. M. Warden

Purchasing and Stores

John G. Hilgen, storekeeper of the Chesapeake & Ohio at Newport News, Va., has been transferred in the same capacity to Russell, Ky.

C. W. Erb has been appointed assistant storekeeper of the Pennsylvania, with headquarters at Trenton, N. J., succeeding D. B. Cooper, retired.

F. H. Potter has been appointed division storekeeper of the Pere Marquette, with headquarters at Saginaw, Mich., succeeding B. J. Abbott, resigned.

J. L. Harbry has been appointed division storekeeper of the Pere Marquette, with headquarters at Grand Rapids, Mich., succeeding H. J. Van Ness, resigned.

F. W. Meier has been appointed local storekeeper of the Duane shops of the Cleveland, Cincinnati, Chicago & St. Louis at Terre Haute, Ind., succeeding H. C. McCoy, resigned.

F. S. McClung, whose promotion to purchasing agent of the Texas & Pacific, with headquarters at Dallas, Tex., was reported in the March *Railway Mechanical Engineer,* entered railway service in October, 1908, as a storekeeper on the Illinois Central at Louisville, Ky. He entered the service of the Texas & Pacific in 1910 in the stores department, and in 1921 was promoted to general storekeeper. Mr. McClung held this position until his recent promotion to purchasing agent.

Obituary

A. B. Clark, shop superintendent of the Chicago Great Western at Oelwein, Ia., died suddenly on February 11.

Harry Wanamaker, district superintendent of motive power of the New York Central, with headquarters at Albany, N. Y., died on March 23 at Elkhart, Ind., from pneumonia while on an official trip for the company. Mr. Wanamaker was born on August 5, 1866, at Pottsville, Pa. He received a high school education and began railroad work on August 1, 1884, with the Philadelphia & Reading, as a machinist apprentice. He was promoted to machinist in 1888 and served in that capacity until 1896, when he was appointed gang foreman at Reading, Pa. He left the Philadelphia & Reading in March, 1900, to become a foreman in the erecting shops of the New York Central at West Albany, N. Y., where he remained until 1905, when he was transferred to Depew, N. Y., as general foreman. On January 1, 1912, he was appointed superintendent of shops, with the same headquarters, and was transferred to West Albany on May 20, 1912. On July 1, 1920, he was promoted to district superintendent of motive power at Albany, and on September 1, 1922, he was appointed assistant superintendent of motive power. On December 10, 1923, Mr. Wanamaker was appointed district superintendent of motive power, with the same headquarters, the position he was holding at the time of his death.

H. Wanamaker

The German General Electric Company has delivered to a Dutch concern the first of three internal combustion motor-driven cars for use on the Kampen Zwolle, Province of Overijsel (Holland) railway line. The motors were constructed by a Berlin company and the car and other equipment were turned out at Cologne. The car came from Cologne under its own power. The car is supported by two two-axle trucks, one axle of each of which is operated by a 75-hp., 6-cylinder gasoline motor at either end of the car. Transmission, reverse and throttle are operated by compressed air. Controls are situated on both end platforms and the motors may be regulated individually or jointly. The control mechanism includes a "dead man's handle" that provides an automatic stop device. The car is intended for one-man operation, has Westinghouse brakes and Bosch dynamo lighting, and is heated by the radiator water. The body is entirely of steel. Fuel consumption is reckoned at six-tenths of a liter of gasoline per kilometer, costing about six cents. The maximum speed is 75 kilometers an hour. The car contains 25 second-class and 40 third-class seats, with 20 places for standees.

Railway Mechanical Engineer

Vol. 98 May, 1924 No. 5

The Winner of The Spray Painting Competition Prize

In the November issue we announced a prize competition for the best article dealing with a number of questions with respect to the application, limitations and future of the mechanical application of paint to railway equipment. Although this subject is one in which we know there is considerable interest, few of our readers apparently care to give a public expression of their opinions on it. One good paper was received, however, which is fully worthy to be awarded the first prize. This was submitted by J. W. Gibbons, whose work on the Atchison, Topeka & Santa Fe is well known, and who is thoroughly competent to discuss the possibilities and limitations of mechanical painting. Mr. Gibbons' article will appear in an early issue and we believe will be worthy of the most careful consideration.

Winners in Equipment Design Competition

In response to announcements appearing in the December and January issues of the *Railway Mechanical Engineer,* seven contributions were received in the competition for the best paper on the relation between equipment design and maintenance, telling what can be done to secure improvements in design to facilitate a reduction in the cost of maintenance. Every paper received contains some good suggestions for the designer. Some of these were prepared by designers themselves, while others were prepared by men who view this problem from the maintenance standpoint. It was one of the latter type which was selected as the winner of the first prize because of the number of specific, practical suggestions it contained for improvements in the design of locomotive details which will facilitate or reduce the cost of maintenance. This paper was submitted by Charles Raitt, assistant master mechanic, Atchison, Topeka & Santa Fe, Prescott, Ariz. The paper which won the second prize was presented by H. Y. Carpenter, who views the problem as a designer. Mr. Carpenter is an employee of the Davenport Locomotive Works, Davenport, Iowa. These papers will be published in early issues.

Jigs for Shoes and Wedges

It seems to be the general practice to machine shoes and wedges on a planer. The advantages to be gained by using a milling machine for this sort of work were brought out in an editorial in the February, 1923, *Railway Mechanical Engineer.* However, a large number of shops are not equipped with milling machines suitable for turning out such work in sufficient quantity and, therefore, must use a planer. As a result, numerous devices for holding the work on the platen so as to eliminate the necessity of having to reset in order to finish the various surfaces, are being used in many shops. That there is considerable uniformity in the nature of the devices used should not be surprising to those familiar with the requirements of such work. Practically all of the jigs in use hold the work at the ends so as to permit travel of the tool from one end of a row of shoes or wedges to the other and at the same time permit adjustment for the top or side surfaces as desired. In each case the chief object of the jig has been to eliminate resetting. The idea, however, that jigs and methods can be improved to facilitate the work of setting, as well as to expedite the completion of the job, does not always get the consideration it deserves. From the standpoint of the operator, this feature is really the most important and should be given the most careful study. A jig which requires three-fourths as much time to set up and machine a half dozen shoes or wedges by a complicated method of clamping as it does to perform the same work on as many individual pieces would be more valuable as scrap. Jigs are being used in a number of shops that have effected real savings in labor, and descriptions of a number of these jigs have been published from time to time in the *Railway Mechanical Engineer.* A comparison of the relative merits and possibilities of the devices used in various shops for machining shoes and wedges should eliminate those with outstanding faults and tend to bring about more efficient practice.

How Do You Handle Car Material?

There has been a great increase in the amount of freight equipment acquired by the railroads in recent years and a corresponding increase in the weight and number of parts that must be kept on hand at repair points. Old methods of carrying stock and supplying the needs of the car department have been outgrown at many shops and repair tracks, and there is need for a revision in the methods of supplying, storing and handling material.

With the hundreds of items now used on car repair tracks, for example, it is impracticable for each repair man to look up his own material because of unfamiliarity with its exact location and the length of time necessary for him to find it. Moreover, car men should not be required to do their own trucking. It has been found more advantageous to put in a delivery system of supplying repair materials directly to the cars and thus keeping the repair men at productive work. A specialized delivery force of laborers for the purpose of handling all the materials is an investment which amply repays the time and expense required to develop it.

All material of one kind should be located in one place so that it can be regularly checked, orders placed before replenishing the stock, obsolete material eliminated, and the stock of slow-moving material curtailed. It is essential that no unnecessary stock be carried, as the expense often amounts to 20 per cent or more of the value of the material and railroad capital is tied up in material when it is perhaps badly needed for other purposes.

The use of tractors and trailers for the handling of material has proved very economical. The best results always

follow the close co-operation of the stores and car departments in ordering and handling material as in this way excess stocks are avoided and, on the other hand, a minimum number of delays to equipment are experienced because of lack of material. The delivery force can often advantageously take charge of the removal of scrap material from the repair track, gathering up good material and putting it back into stock, in addition to delivering the new material to the cars.

Treated Lumber in Car Construction

It has been said that the use of treated lumber in car construction will effect larger savings to the railroads than any other feature of car building developed in recent years. Whether or not that statement is fully true, the rapid decay observable in sills, decking and roofing of all-wood and composite freight cars is ample evidence of the need for treatment which will prevent the action of decay in car timber and hence increase the life of the cars. The universal treatment of timber for railroad car and bridge construction was advocated by H. S. Sackett, consulting timber engineer, Chicago, in an article published in the April 26, *Railway Age*, from which the following significant statement is quoted: "The decay of timber and lumber in freight cars represents a yearly loss of approximately $60,000,000 in material, labor and loss of revenue, equivalent to somewhat over 15 per cent of the average yearly gross revenue per car. There are more than $1,500,000 freight cars in service which contain wood where it is subject to decay."

An investigation made by the American Wood Preservers' Association over a period of two years is said to have shown 80 per cent of the repairs to wood and composite freight cars to be caused by the decay of wooden members, the chemical treatment of which would have caused them to outlast their period of mechanical usefulness. Mr. Sackett gave the figure of $50 as the approximate cost per car for lumber treatment and when the resultant increased life of cars is taken into consideration practically any method of figuring will show a handsome profit on this investment.

Another authority on timber treatment submits the following as the life of untreated car timber most subject to decay: "Stock car decking, two to five years, stock car sills, five to eight years, stock car roofing, four to six years, flat car decking, six to eight years, flat car sills, eight to ten years, box car sills, six to ten years, refrigerator sills, four to five years." It will be noticed that the stock car decking is subject to the most rapid decay, lasting only from two to five years, according to this analysis. A prominent mid-west railroad built a number of new stock cars in 1911, using treated sills and decking and it is said that these cars are still in service with the original treated material in good condition. In this case the timber was treated with creosote by the full-cell process and the result was an increase of car life from about five to certainly more than thirteen years.

It is a well established fact that timber treatment by any of the standard recognized processes checks the action of decay and enables a much longer life to be obtained from car material. Not only is the life of car timber itself increased but the premature failure of car members subject to stress in largely prevented. Mechanical failures attributed to faulty design are frequently caused by decay in its early stages which is not easily discernible but which nevertheless reduces the strength of the wood 40 per cent or more. With the increasing price of lumber due to scarcity and the constant urge for reduced net maintenance costs, there is little question that the railroads will go more and more to the use of treated lumber in car construction, particularly for those parts of wooden and composite freight cars subject to rapid decay.

Should Production Be Curtailed?

Doubtless many mechanical officers have wondered whether it really pays to rate a shop on its maximum productive power. It is a fact generally recognized by manufacturing concerns that after production passes a certain point the profits per unit tend to decrease; that is, each plant is limited as to the amount it can produce with the greatest economy. This factor must also be applicable to railroad shops that perform classified repairs and production work for an entire system. Therefore, the mechanical officer in charge of such work is justified in attacking his problem by assuming that maximum production is not always economical production.

On another page of this issue there is an exceedingly interesting article contributed by one of the mechanical department officers of the Buffalo, Rochester & Pittsburgh. One cannot help but be impressed with the fact that the management has seen fit to limit the number of locomotives allowed in the erecting shop at one time. "This allotment," the article states, "has demonstrated its wisdom, as plenty of room is thus provided for working access to the locomotives. In addition to insuring that all material is properly placed, the congestion that naturally follows when a large number of locomotives is in the shop at one time is eliminated."

There are, however, a number of things to be considered before any railroad can decide as to what should be the ideal production for its main shops. The business of railroading differs from that of an industry engaged in manufacturing and marketing what it manufactures. If the shop sold the locomotive, the problem of setting a figure would not be so difficult, but its problem is to keep the locomotive running. This means that the management must know whether the amount of money the locomotive can earn on the road will render sufficient profit to justify the waste in material and wages that is inevitably incurred by crowding the shop. Perhaps some mathematical expert will take the various figures involved and work out a factor of production by which shop output can be determined upon a basis of transportation demands. Such a factor would be a big help in the solution of many railroad problems, but no solution to this problem is possible without close co-operation between the mechanical and operating departments.

Curtailment of production in order to get the most efficient and economical results in shop work is worth careful study by all mechanical officers and men. The operating department can be a big help in arriving at the proper production figure by seeing that the equipment is used to the best advantage. A shop that is not operating at its maximum capacity has something to fall back on when an emergency arises. On the other hand, when a shop is required to operate under congested conditions when traffic is normal, it would pay the management to make an investigation and ascertain if the waste being incurred might not justify an appropriation for buildings and equipment to increase the capacity so that the shop could be run economically.

What Can Be Done

Probably the performance of the Kansas City Southern shops at Pittsburg, Kans., in making a record of seven hours fifty-five minutes for the completion of Class 3 repairs to a heavy Consolidation type locomotive will be regarded with skepticism by many of those who read the account on another page in this issue. It is not the purpose here to enter into any defense of the details of this or of any other similar records which, to some extent, are open to the criticisms that they are "stunts" and that they were made possible by employing impracticable methods. It is enough to call attention to the fact, however, that skepticism is the respect usually paid to all accomplish-

ments which stand out in a marked degree above the average and that it might be well before dismissing the matter as of no practical consequence, to examine carefully into the circumstances to see if there may not be some suggestions for changes in customary practice from which real practical benefits can be derived.

In the account of the Kansas City Southern's record performance will be found three significant facts. In the first place, the officers responsible for the operation of the shops were not satisfied that the full resources of the facilities at their disposal were being utilized, and were not content to continue the old routine without at least a trial of the possibilities of something different. In the second place, the complete utilization of these resources depended on the whole-hearted co-operation of every man in the organization, and apparently that co-operation was fully secured by the interest, shared by officers and men alike, in finding out whether a difficult trial of skill and organization could be accomplished. Every man shared, and has a right to a feeling of personal pride, in the result.

In this particular case, however, the most significant circumstance, and the one most likely to stamp the whole performance as being in the "stunt" class, is the large extent to which the manufacturing departments were eliminated as factors in the progress of the locomotive from stripping to completion. Obviously it would be impossible to complete a Class 3 repair job if the locomotive had to be held while the boiler tubes were cleaned and safe-ended, the tires turned or reset, the driving boxes rebored or refittd and relined, and new bushings applied to the rods. The possibility of such a performance, however, becomes an entirely different matter when the schedule is controlled by the time required to remove from the locomotive one set of parts and replace them with others which have been repaired before the original parts were removed. Including the time required to break in the locomotive, this separation of the floor operations from those of the manufacturing or repair departments means a loss of service time for the locomotive of only two days instead of from thirteen to fifteen days or more were the engine to be held until all of the original parts could be restored.

How far this duplication of parts may be found economical probably will depend on many local conditions, such, for instance, as the number of locomotives of a given class which may be served by a single set of spare parts and how valuable from an operating standpoint the saving in service time of a given class of locomotives may be. The first phase of the problem is one requiring considerable study; the second should be comparatively easy of determination. In most cases the saving of approximately half a month for every Class 3 repair turned out is of such tremendous importance as to justify a careful study of the possibilities of a fairly complete separation of the repairing operations from the erecting operations.

To Whom Does Responsibility Belong?

In a recent address before the Pacific Safety Council on The Management's Responsibility toward Its Employees, Paul Shoup, vice-president of the Southern Pacific, made the following statement: "Never has it been demonstrated to me where the line of cleavage (between management and employees) is and I am not at all sure that I ever want such a demonstration. Indeed, if we can arrive at the point where there is no longer a discussion of who constitutes the management and who constitutes the employees, then and then only will the responsibilities of everyone in the organization become individual with respect to all others engaged in that same enterprise."

Personal responsibility, touched on by Mr. Shoup, is a phase of the personnel question on which not enough stress has been laid. If every railroad man had a clear conception and keen sense of his personal responsibility—to his own ideals; to his fellow-employees, whether superior, equal or subordinate in rank; to the organization he agrees to serve—there probably would be no railroad personnel problem.

The present difficulties in personal relationships are generally attributed to the growth of organizations to their present gigantic proportions, in which the former personal relationships between the employee and the employer have been replaced by contact between thousands of employees acting en masse on the one hand and an impersonal management on the other. Mass action tends definitely to weaken the sense of individual responsibility. An extreme demonstration of this fact is afforded by the action of a mob which in utter irresponsibility may perform deeds revolting even to the most insensible of its members, unless, perchance, a leader of high ideals steps forward to direct its course.

On the other hand, close personal relationships tend to stimulate the sense of personal responsibility and in no small degree it is this fact which inspires the frequent expressions of regret at the loss of the old individual relationships in railroading, heard alike from executives and men in the ranks.

But the size of a large organization does not necessarily preclude the establishment of personal relationships of a kind to awaken effectively the sense of individual responsibility. The truth of this statement is demonstrated by the army where the effectiveness of the organization is greatly enhanced by the keen sense of personal loyalty usually found to exist between the officers and the men in the ranks. This loyalty is not primarily that of the men for the directing head of the organization, but is a mutual relationship between the men and their company commanders.

The compulsion of military discipline does not and should not exist in the railroad organization, but the same type of personal loyalty with its stimulating effect on the sense of individual responsibility can and should exist in every department of the railroad.

The foreman is the key to this situation. On the quality of his personal leadership depends the effectiveness of the whole organization far more than on the executive and managing officers. Loyalty is a mutual relationship. Few men can inspire it unless they give it in equal degree. The loyalty to the interests of the men whose work he directs is as much an obligation of the foreman as is his loyalty to the company by which he is employed. Any foreman who has not this conception of his job is a misfit.

But the responsibility does not alone rest with the foreman. If there are men in supervisory ranks who lack, or in whom this essential quality of leadership has never been developed, how did they get there? The responsibility for such a condition is to be shared by every officer in the organization, up to and including the president, and it is a personal responsibility which will only be discharged when each one has taken the active interest suitable to his position required to bring about effective training and selection of supervisors for leadership, from the lowest ranks up.

New Books

VIEWS AND REVIEWS OF THE HOT BOX SITUATION. *By J. C. Stewart, general foreman and traveling car inspector, C. I. & W., 50 pages, 4½ in. by 6 in. Price 50 cents. Published by J. C. Stewart, 51 N. Warman Ave., Indianapolis, Ind.*

This book, dedicated to the "better care of journal box and contained and contributing parts," should prove a real inspiration as well as assistance to railroad men in the solution of hot box troubles. The author writes from long experience and the book indicates his broad grasp of the fundamentals of the problem. It plainly shows the desirability of more

uniform methods of journal box maintenance and journal lubrication, due to the interchange of cars from one road to another. The detailed causes and remedies for hot boxes are discussed and particular emphasis laid on the importance of system and perseverance in any attempt to improve conditions.

MECHANICAL WORLD YEAR BOOK, 1924. *Published by Emmott & Co., Ltd., Manchester, England. 348 pages, 3¾ in. by 6 in. Price, 1 shilling 6 pence net.*

The 1924 edition of this handbook contains a number of new sections that tend to increase its usefulness. There is a new and rather lengthy section on fuel combustion. A number of sample problems in flue gas analysis are worked out and also a number of useful tables are given. A section embodying the various rules and formulæ for calculating the strength of flat plates has been added in this edition, as well as a section on tanks. The book is primarily a reference for engineers, draftsmen and practical mechanics and is written for those engaged in work that is being done according to British practice. The various units used are those standard in Great Britain. However, it contains considerable information that is common engineering practice in this country.

PRINCIPLES AND PRACTICES OF UPKEEP PAINTING. *Edited by Roy C. Sheeler. 6 in. by 9 in. 200 pages, illustrated. Bound in fabrikoid. Prepared and published by the E. I. du Pont de Nemours & Co., Philadelphia, Pa. Price $2.*

The text of this book covers in simple, practical fashion modern painting practice for all types of exterior and interior surfaces. It shows both by text and by illustration, the reasons for decay and deterioration of materials and paints and describes the latest and most modern methods to follow in overcoming these difficulties. Each class of building material is handled separately and the methods of surface preparation, paint application, etc., are given in detail. While the entire book forms a practical guide of use to railway men in the handling of plant and equipment maintenance it is likewise of value in regard to new construction. One section of the book of particular interest at the present time is a chapter on mechanical painting in which are included important facts on this method of painting, the care of the equipment and comparative figures on costs.

GENERAL FOREMEN'S ASSOCIATION 1923 PROCEEDINGS. *Compiled and Published by William Hall, Secretary of the Association, Winona, Minn. 210 pages, 6 in. by 9 in., bound with semi-flexible covers.*

This book is a record of the proceedings of the seventeenth annual convention of the International Railway General Foremen's Association held at the Hotel Sherman, Chicago, September 4 to 7 inclusive, 1923. The book is of particular interest because, in spite of a lapse of two years since the last annual convention, the 1923 proceedings proved beyond question that the association is coming back strong and promises to be a constructive force in increasing the efficiency of railroad operation. The Railway General Foremen's Association is one of the strongest of the minor mechanical department associations and has great possibilities for disseminating much needed information regarding railroad shop "men, machinery and methods." A picture of George H. Logan, general foreman, C. & N. W., the present president of the association, is published on page 5, followed by a report of the opening exercises of the convention, the annual report of the secretary-treasurer and the usual committee reports and discussions. The proceedings also contain the highly inspirational address by James C. Davis, director-general of railroads, on the subject "Responsibilities of American Citizenship," an address which will be remembered with pleasure and profit by all those who attended the convention.

What Our Readers Think

Loose Crown Brasses

BINGHAMTON, N. Y.

TO THE EDITOR:

The question raised by Matthew Devlin, in the April issue of the *Railway Mechanical Engineer*, relative to loose crown brasses might be solved by the following procedure:

Make the brass about one thickness of paper, say, .005 in smaller than the bore of the box, and tip the calipers enough to allow for the pressure required to force the brass in. It will be found that the pressure may be raised considerably while pressing in the brass without the box being sprung out of parallel. This has the effect of drawing the box together and gives a solid fit into the dovetailed annular channels in the box, as the brass has to expand to fit on the sides.

JOHN C. MURDOCH.

How Do You Keep Your Reference File?

CORONATION, Alberta, Canada.

TO THE EDITOR:

I would like to know of a convenient and practical way of filing and indexing various private notes that I want to keep in connection with my work. For instance, I copy articles from your paper and other publications, as well as the company's literature, with the idea of having a compact and handy reference library available when needed. This material has grown to considerable proportions, but is not of much use because the articles I want are not always easy to find.

Any suggestions that you or your readers might have will be appreciated.

J. BOYD,
Locomotive Foreman, Canadian Pacific.

Defective Air Brakes on Freight Cars

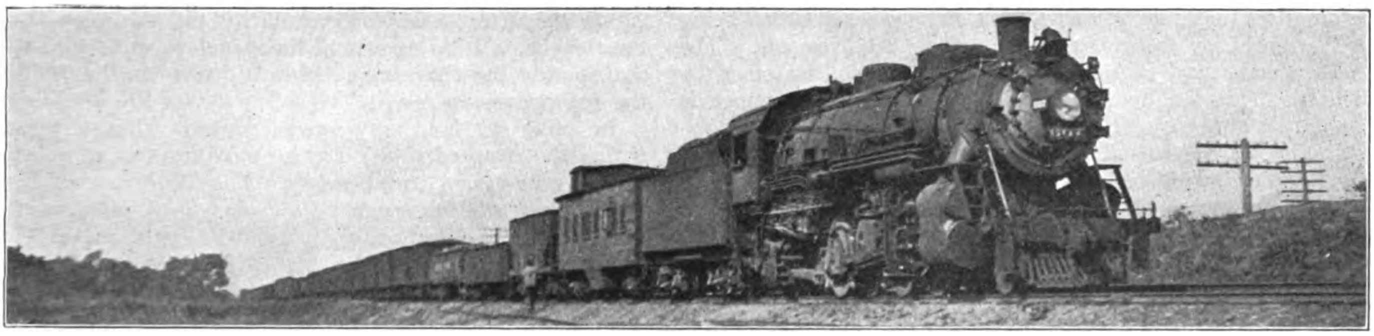
LOS ANGELES, Cal.

TO THE EDITOR:

Air brake defects are regulated the same as any other I. C. C. defect but the inspection is not quite so rigid. Most of the trouble on this road is in the retainer pipe and retainers. A great many of the retainer pipes are split, some are entirely rusted off and a large number are broken at the elbow near the end sill. There have also been cases where the pipe has been rusted out on cars equipped with wooden end sills. Of course, these defects cannot be found until the trains are made up and an air test has been made. Such defects have often delayed manifest trains from one hour to 1½ hours. The officers do their utmost to expedite all train movements and sometimes severely criticize the car department for such delays. I believe that if all the cars were tested at interchange points and placed in good condition before proceeding to their destination, there would be very few, if any, delays for the reasons just stated, at central points. A great many foreign cars travel several thousand miles before such conditions are found. If all roads would insist on the air brake equipment being 100 per cent before delivery to the receiving line, the most of this trouble would be eliminated.

I would like to have someone else give their views on this subject.

BRYAN BARTON,
Gang Foreman Car Repairs, Southern Pacific.

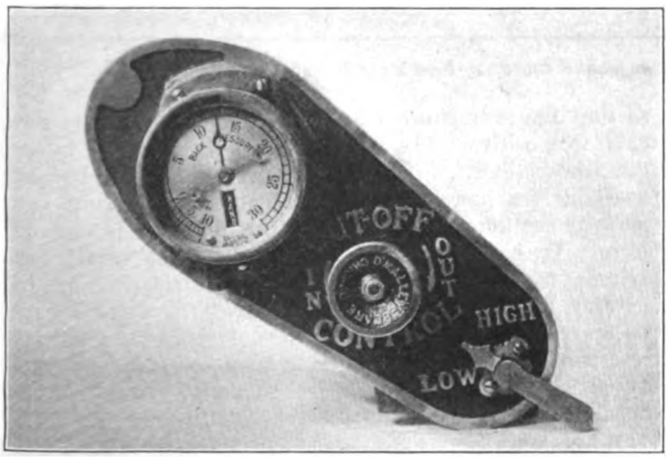


Nickel Plate Light Mikado, Equipped with Automatic Cut-off Control, Hauling a Dynamometer Car and Test Train

Service Tests of Automatic Cut-Off Control

The Control Device Described—What Its Performance on Two Railroads Has Demonstrated

THE total absence of any means for automatically regulating the point of cut-off in steam locomotives, up to the present time, is contrary to the almost universal use of such regulating devices in the field of the stationary engine. From the days of the first steam locomotive, the operation of the reverse lever has been by the effort and



The Engineman's Back Pressure Gage and Control Panel

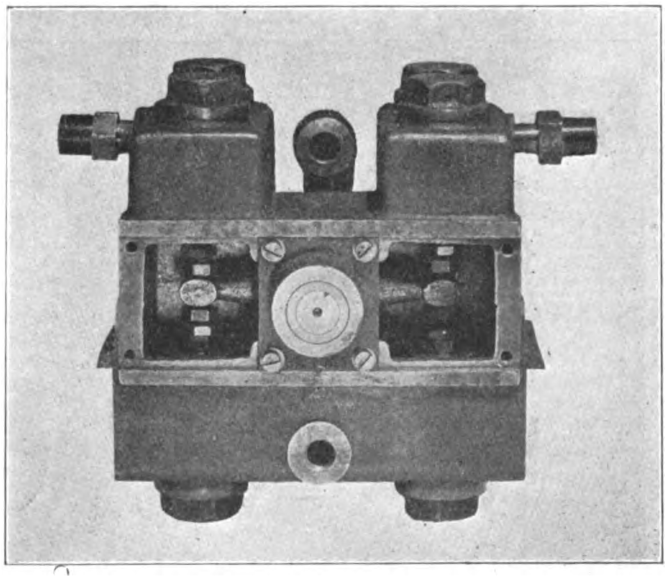
at the direction of the engineman. The development and practical application of a mechanical device, therefore, to perform this operation instead of the engineman, marks the opening of an entirely new field in locomotive development. It is apparent from data already secured that automatic control of the point of cut-off provides the possibility of a marked improvement in locomotive operation.

Device for Automatically Adjusting Cut-off

The mechanical device, tests of which are described in this article, is known as the Automatic Cut-off Control, made by the Transportation Devices Corporation, Indianapolis, Ind. It is actuated by the pressure of the steam in the exhaust passages of the cylinders, and connected to a power reverse gear. The controller, or principal part of the device, is mounted above the power reverse gear and in front of the reverse gear valve. It is contained in a metal box 23 in. by 18 in., by 13 in., located as shown at *A* in the illustration of the locomotive.

The controller is connected to all four exhaust passages of the cylinders by a one-inch pipe. Exhaust pressure is conveyed by this pipe to the pressure regulator unit of the controller and also back to the cab where it terminates in the back pressure gage mounted on a small control panel shown in one of the illustrations. A second pipe connects the controller with the main air reservoir from which the controller obtains its source of power to adjust the reverse gear and hence the cut-off.

Tests made in road service apparently show that, for any given locomotive, dependent on type, size and boiler pressure, there is a definite constant back pressure which, if maintained constant at all speeds above which it is first reached, will permit maximum rated drawbar pull to be developed. This back pressure is held constant by lengthening the cut-off as the speed decreases and shortening the cut-off as the speed increases. Should the boiler pressure change in addi-



The Reverse Gear Valve Assembly with Poppet Type Valves

tion to a change in speed, the cut-off adjustment will be made accordingly. The proper exhaust pressure to be maintained is shown by the idle hand on the back pressure gage mounted on the control panel in the cab; the actual pressure existing is shown by the movable gage hand.

Once the proper pressure for a particular locomotive is determined, the pressure regulator is so set and this setting is known as "High." A second setting, which may be any-

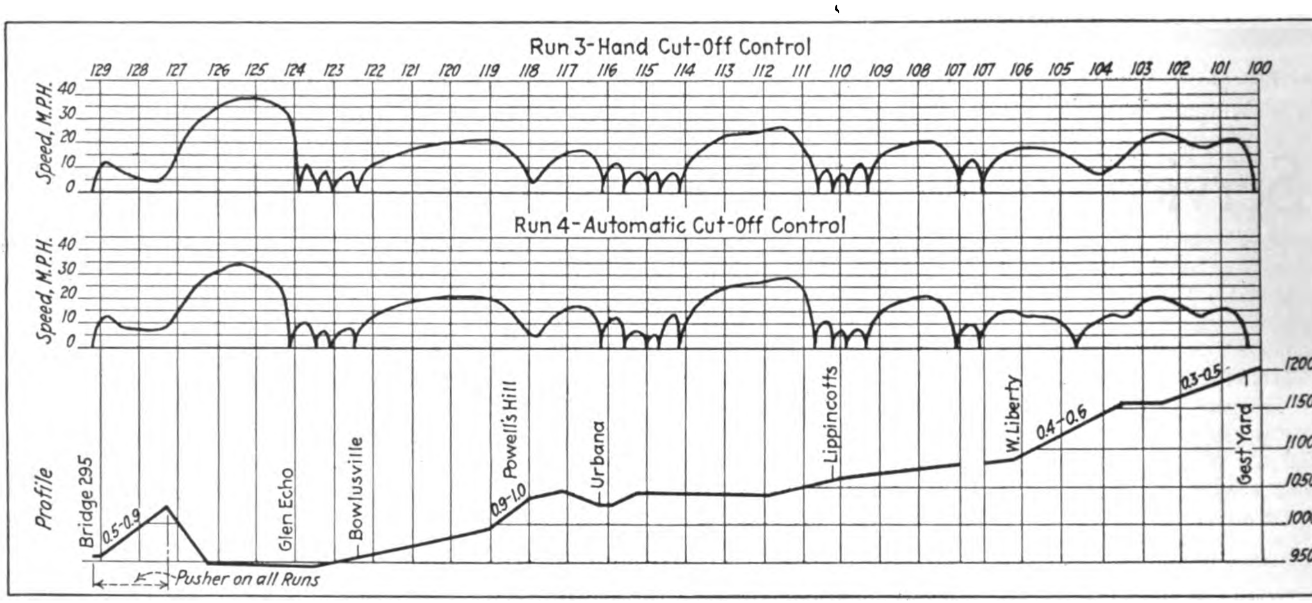
thing less than the "High" setting, is known as "Low," being determined by the minimum operating requirements. The engineman may change from one setting to the other by means of the handle at the right end of the panel, which is pointing either on "High" or "Low."

Whether the cut-off is to be adjusted by the engineman or by the device depends on the throttle opening. A pipe is run from the right steam pipe back to a primary control valve in the cab. This primary control valve is designed to be set so that with the throttle more than 60 per cent open the Automatic Cut-off Control makes adjustments of the cut-off.

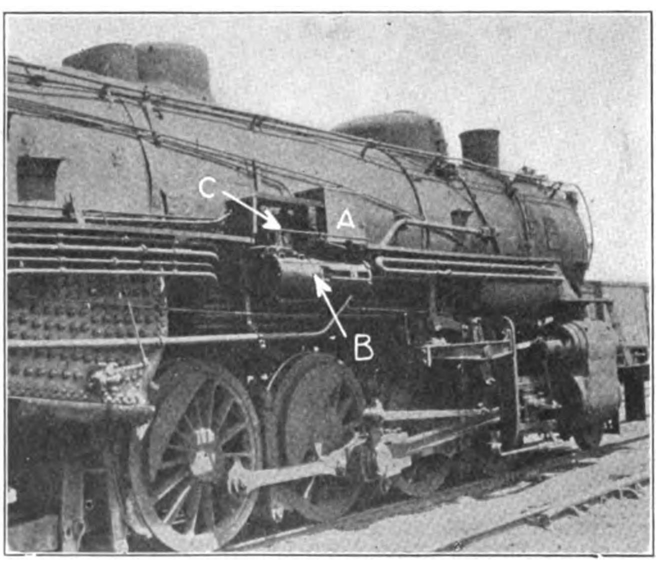
The air supply from the main air reservoir passes through this valve and the action of steam pipe pressure is to supply or cut off the supply of air to the controller. A small slot in the dial of the back pressure gage displays the word "Hand" when the reverse lever is subject to the operation of the engineman and "Auto" when operated by the device.

The engineman can cut the device in or out by the position of the throttle, or permanently cut the device in or out by turning the valve wheel located in the center of the panel. Again the device can be momentarily cut out, even though the throttle is fully open and the panel valve is also open. To do this the engineman holds his foot on the pedal of the foot valve.

In order to hold any predetermined exhaust pressure within the required limits, certain modifications in standard reverse gear design are necessary. The modifications consist of the poppet valve design of the reverse gear valve to eliminate the lap and lead of the slide and rotary valves. Lap and lead must be of independent adjustment and negligible so that fine adjustments and quick response of the reverse gear are positive. The valve of this gear is shown in one of the illustrations. Since the reverse lever must be always available for hand operation and at the same time free to move under automatic operation, the quadrant is circular in form. With hand control the piston of the small locking cylinder at the bottom of the quadrant is against the quadrant, holding it stationary. With the Automatic Cut-off Control in operation the quadrant is free to rotate and allow the lever to follow the gear. The locking cylinder is controlled by the primary control valve, actuated by the throttle opening.



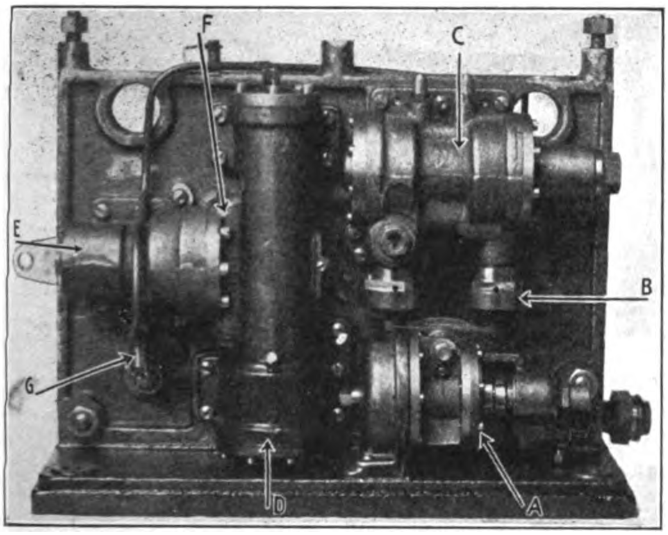
Speed Records and Track Profile of Two of the Big Four Fuel Test Runs



Location of the Controller Box (A) and Poppet Type Reverse Gear Valves (C) with Respect to the Reverse Gear (B)

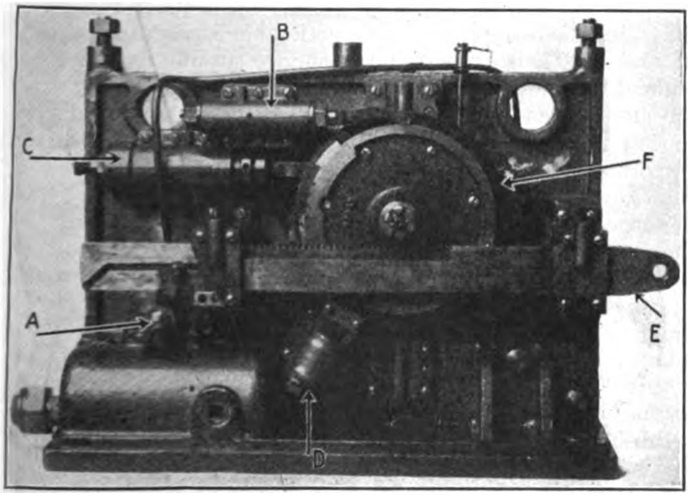
In operation, the locomotive starts the train with the reverse lever in the front corner and the throttle open so that the device cuts in as shown by the word "Auto" on the gage. As the speed increases the back pressure builds up as shown by the gage. If the engine is to be operated at 9 lb. exhaust pressure, when the pressure builds up to 10 lb. the pressure regulator actuates the reduction valve and the controller causes the gear to be hooked up until the pressure is reduced to 9 lb. This will be kept up until the maximum speed is reached and the cut-off is at its shortest, when the controller is prevented from going into back motion. If at any time a grade or other condition should be encountered that would cause the pressure to drop to eight pounds, the cut-off will be lengthened and nine pounds back pressure restored. This may keep up until the reverse lever is again in the corner. The differential of one pound above and below the constant is as close as practical operation will permit, although the controller is said to be capable of one-quarter pound differentials. The exact value of the back pressure maintained has no bearing on the operation of the device which is designed to adjust itself to any pressure to which it is set, the characteristics of the locomotive establishing the "High" setting and minimum operating conditions, the "Low" setting.

Should the engineman at any time close the throttle, the reverse lever will remain where it was before the throttle was closed, and not go to the corner. The engineman, when the device is cut in, cannot move the reverse lever to any other



Front View of the Locomotive Cut-Off Controller with the Cover Removed—(A) Duplex Pressure Regulator, Set to Hold Desired Exhaust Pressure Constant; (B) Reduction Valves Opened by Pressure Regulator, Left Valve Lengthening and Right Valve Shortening Cut-Off; (C) Distributing Valve, which Feeds Air to All Operating Parts on Impulse of Reduction Valves; (D) Operating Cylinder, Which Moves the Mechanical Connections to the Reverse Gear; (E) Cylinder Supply Valve, Feeding Air to and Exhausting Air from the Operating Cylinder; (F) Reversing Head, Governing the Operation of Piston in Operating Cylinder; (G) Primary Adjustment Speed Regulator, Which Governs Rate of Adjusting Long Cut-Offs.

position than that fixed by the controller. He may, however, turn from "High" to "Low" setting, which will immediately change the cut-off to the lower exhaust pressure. To control properly the pulsations of the exhausts at low speeds, a uni-



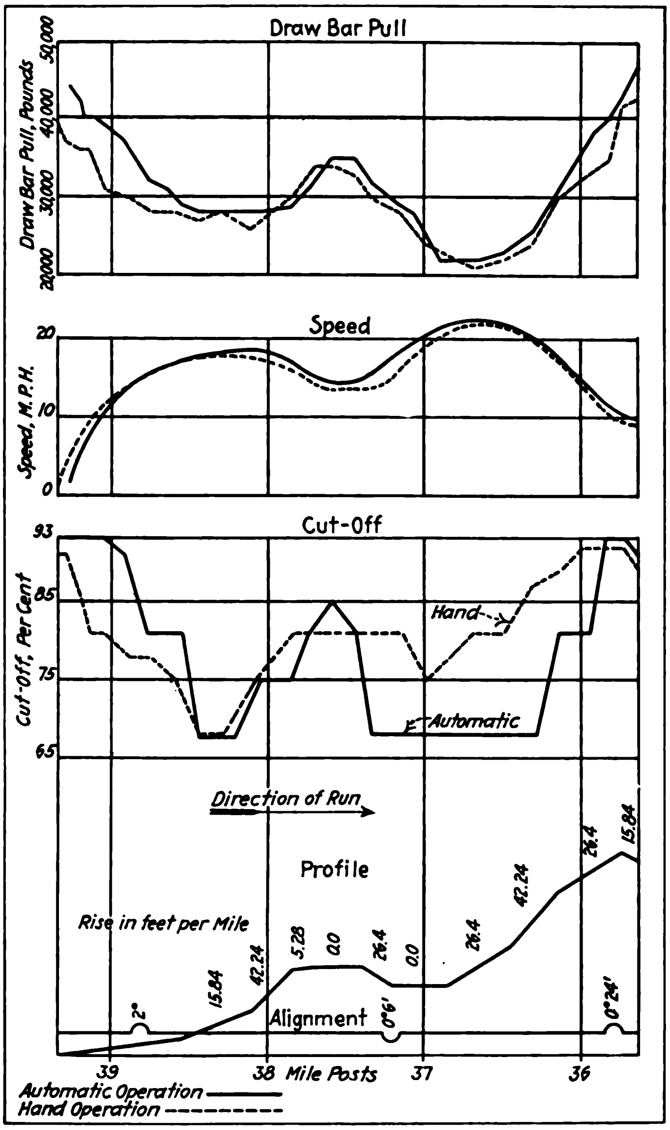
Rear View of the Controller—(A) Secondary Adjustment Speed Regulator, Governing Rate of Adjusting Long Cut-offs; (B) Intercepting Valve, Which Stops Cut-off Adjustment When Longest Cut-off Has Been Reached; (C) Cam Cylinder, Which Determines Whether Operating Cylinder Will Lengthen or Shorten Cut-off; (D) Friction Cylinder Which Maintains Cut-off as Set by the Machine; (E) Operating Rod, Connected to the Reverse Gear Floating Lever by Reach Rod; (F) Ratchet Wheel, Rotated by Opposing Dogs Actuated by Operating Cylinder Piston

flow fitting is inserted in the back pressure line between the cylinders and the controller.

The locomotive engineman has no guide other than a varying degree of experience to assist him in determining the proper cut-off to use. Again because of the many other duties, the attention to which is vital to safety, he is deprived of time, particularly continuity of time, to adjust cut-off. It is the function of the Automatic Cut-off Control to provide accurate and constant adjustments of cut-off and to do this without the attention of the engineman.

Nickel Plate Tests Automatic Cut-off Control

The effect on speed and drawbar pull of cut-off regulation as performed by the engineman and by the Automatic Cut-off Control under competitive test conditions is shown graphically in a chart typical of a series taken from dynamometer car tests of a Nickel Plate light Mikado locomotive, stoker fired, on a three-mile section of test track. Each run required about 15 min. The maximum grade was 42.24 ft. per mile, and



A Comparison of Draw Bar Pulls, Speeds and Cut-Offs Developed in the Dynamometer Car Tests on the Nickel Plate

the maximum track curvature 2 deg. The same train was backed up to the starting point for each test, the engine and crew being the same in each case.

The results of these tests, as borne out by the charts, may be summarized as follows:

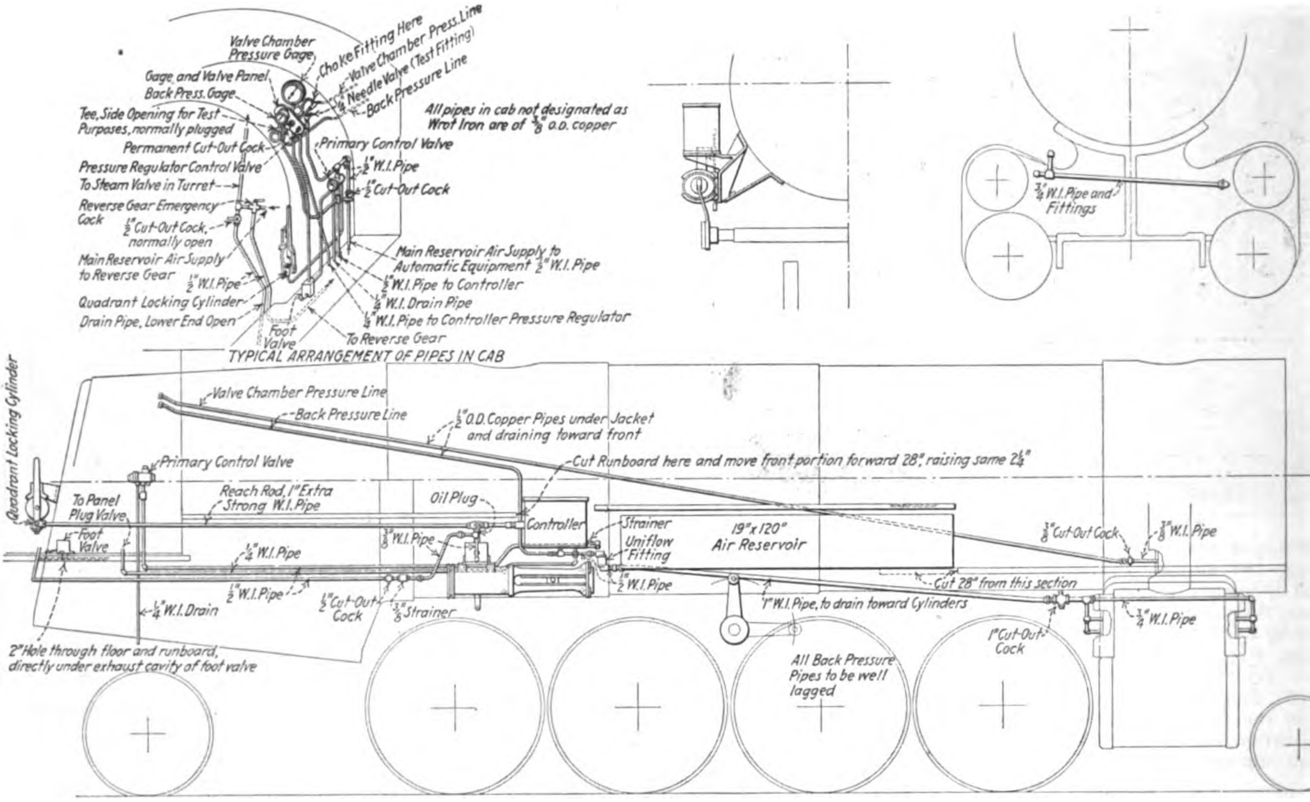
1—There was no appreciable difference in the minimum speeds of the respective trains over the grade where minimum speeds would naturally be expected.

2—There was a decided difference in the cut-offs used by the enginemen and by the Cut-off Control. In starting the

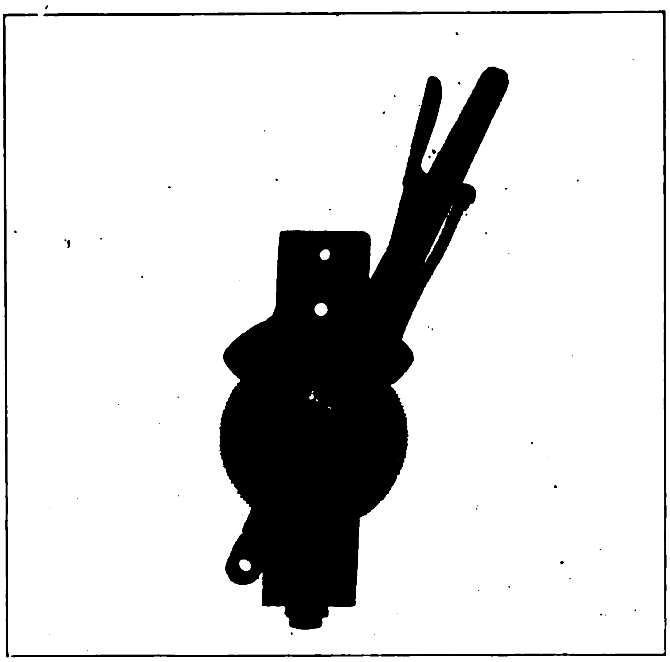
train, the reverse lever remained in the corner longer with the Cut-off Control than when operated by the enginemen, but this was an advantage in getting more quickly to the higher speeds and shorter cut-offs. In slowing down, the Cut-off Control did not hook down the reverse lever as quickly as the enginemen did. In running, shorter cut-offs were used and for greater periods of time when the Cut-off Control was in operation.

3—The Cut-off Control generally showed equal or better speeds, drawbar pull and drawbar horsepower than those obtained by the enginemen, regardless of the longer cut-offs used by the latter.

4—The time performance between mile posts was generally in favor of the Cut-off Control.



General Piping Diagram of the Automatic Cut-off Control



The Reverse Lever Assembly Includes a Circular Quadrant Which Is Held Stationary with Respect to the Bracket, for Hand Operation, by the Locking Cylinder at the Bottom of the Bracket

5—The enginemen as a rule anticipated the grades by lengthening the cut-off in advance of the train actually being on the grade. The Cut-off Control did not lengthen the cut-off until the grade resistance had actually made itself felt upon the train, this being particularly noticeable between mile posts 38 and 37. It is evident that if shorter cut-offs can be used without lessening the drawbar pull or speed for short runs, the cumulative effect over the entire division will be conducive to lower fuel consumption and better time and tonnage performance.

Because of the shortness of the Nickel Plate tests it should be noted that the enginemen were in a position to devote all the time necessary to adjusting the reverse lever and to take advantage of their knowledge of the road-bed gained through years of experience. They could also look ahead and on approaching a grade take advantage of any peculiarity which might make the lengthening of the cut-off advisable had such a thing been the proper thing to do. The fact is that the enginemen really lengthened the cut-off at the wrong time because of their mental attitude as to the necessity for it.

Fuel Economy Tests on the Big Four

In order to determine the effect of the Automatic Cut-off Control on fuel consumption this equipment was applied to a C. C. C. & St. L. Mikado locomotive, No. 160, and a series of tests run between Springfield, Ohio, and Bellefontaine, Ohio. Tests made on the same class of locomotive over the same territory, in April, 1923, had indicated that 13 lb. back pressure was the proper setting for the automatic cut-off governor, and this setting was used during the fuel tests.

A total of four runs were made in the eastward direction between Springfield and Bellefontaine, two runs with the cut-off controlled by the engineer and two runs with the cut-off controlled automatically. The same train was used during

each test, but due to heavy rains during the second, third and fourth tests the train, which consisted entirely of loaded coal cars, gained in weight. An allowance of four per cent of the total weight of lading was added to the original weight to offset this factor.

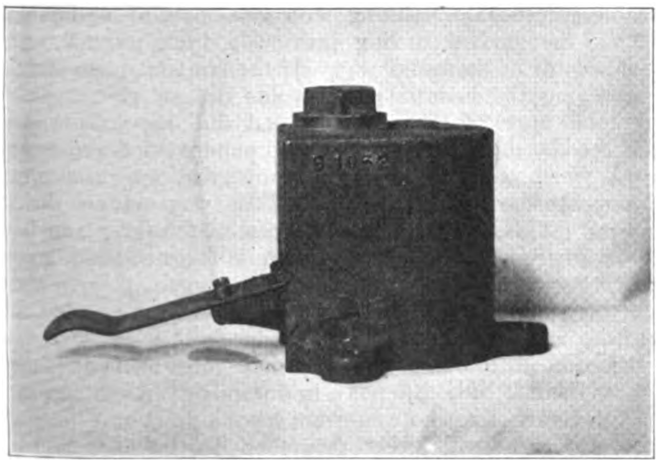
The coal burned during the tests was loaded from one car, held for this purpose at Springfield, thereby keeping the grade of coal burned constant. Coal was weighed onto the tank previous to each run, and the coal left at the end of each run was weighed off. In addition, the weight of the coal fired before and after each test was taken. The coal figures for the test runs, therefore, include only coal actually burned from the start to the finish of the runs.

In order to make the four runs truly comparable, it was necessary to keep the number and location of stops and starts constant. For this reason, every siding was entered, and the moves in and out of each siding were the same on each run. The speed records, two of which, together with the track profile, are included, show how closely the moves of the test runs compare.

TABLE I—GENERAL DATA AND RESULTS OF BIG FOUR FUEL TEST RUNS

	Run 1 Hand	Run 2 Auto	Run 3 Hand	Run 4 Auto
Actual train tonnage	3,597	3,701†	3,714†	3,714†
Adjusted train tonnage	4,347	4,451	4,464	4,464
Running time, min., bridge 295 to Gest yard	158	176	171	169
Standing time, min.	139	158	186	228
Total time on road	297	334	357	397
Average running speed, m.p.h.	11.2	10.1	10.4	10.5
Average max. speed between stops, m.p.h.	16.3	14.1	14.3	14.1
Min. speed over ruling grade, m.p.h.	9.5	4.0	3.5	5.0
Average steam pressure, lb. per sq. in.	191	195	192	194
Coal fired, lb.	14,713	13,709	15,631	12,960
Water evaporated, lb. (10 per cent return by heater)	91,135	92,730	95,480	96,525
Lb. water evaporated per lb. coal fired	6.19	6.76	6.10	7.45
Lb. coal fired per 1,000 gross ton miles	138.8	125.4	142.7	118.1 128.9*

† Includes 103.8 tons, estimated increase in train weight due to rain during test runs 2, 3 and 4.
* Based on mileage to point of stall at mile 104.7.



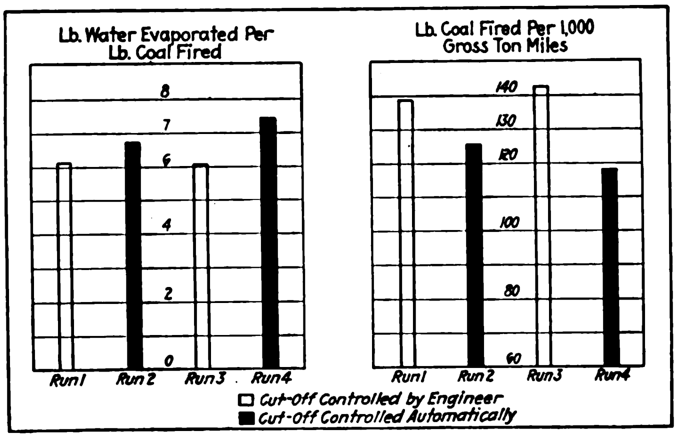
Foot Valve for Temporarily Cutting Out the Automatic Cut-Off Control

The tank of the locomotive was calibrated and water readings taken at each stop. The feed water heater was credited with a 10 per cent return to the tank during each run. The booster engine was cut in at all starts, but was not used on the ruling-grade, Powell's Hill, during runs 1, 2 and 4. On run 3, with hand operation of the cut-off, it was necessary to cut in the booster near the top of the hill.

The standing time in sidings was kept as constant as possible. The time standing was greater on runs 2 and 4, with the cut-off controlled automatically. This, without doubt, caused a slight increase in coal consumption but no effort was made to estimate the amount. Runs 1 and 2 were made with different engineers, while runs 3 and 4 were made with the same engineer.

The stall which occurred between West Liberty and Gest Yard on run 4 was due to a shower which caused bad rail conditions, and inability to get sand to the rail resulted in the engine slipping. A train following pushed the test train about 30 car lengths after which Engine 160 handled the train alone. The coal consumption per ton mile, for this reason, was calculated up to the stalling point and also including the stall.

The general averages developed by the test runs are given in Table I. From the standpoint of fuel economy, the two automatic cut-off runs show an increased water evaporation rate and a decrease in coal consumption per ton mile as compared with the two runs where the cut-off was controlled by the engineer. The results indicate that with this class of locomotive a gain of approximately 10 per cent in water evaporated per pound of coal fired and an approximate decrease of 10 per cent in coal consumed, may be expected by automatically controlling the cut-off.



Graphical Comparison of Big Four Fuel Test Results

It should be noted that the actual running time on all tests, with the exception of the first where the lading was dry and the train lighter, is nearly the same. The more effective firing under the constant draft conditions held by the automatic cut-off combined with more uniform accelerations from stops, account for the increased rate of evaporation and reduced coal consumption, indicated graphically in one of the charts.

Operating Results in Slow Freight Service

The effect of better average drawbar pull and speed on economic operation is shown by the following operating data taken from competitive cut-off control tests in slow freight service on the Cincinnati Northern, a subsidiary of the Big Four:

	All engines same class	Engine with automatic cut-off	Per cent, increased production
Average miles per hour, total time	10.1	11.3	....
Average gross ton miles per hour, 1,000	32.61	39.2	20.2
Average gross tons per train	3,239	3,477	....

This shows the accumulated effect on the rate of production, in terms of 1,000 gross ton miles per hour, of regulation of cut-off to develop maximum rated drawbar pull at each speed.

It is interesting to note that increased tonnages do not reduce the speed as much as might be expected when the cut-

off is adjusted automatically. This is clearly brought out by the following comparison, over the same territory and service:

Actual train tonnage	Speed, running time, m.p.h.
3,300–3,400	15.2
3,400–3,500	14.6
3,500–3,600	14.8
3,600–3,700	14.4

Certain mechanical and operating advantages, claimed for the automatic control of cut-off and substantiated in varying degree by the tests, are as follows:

1—Standardization of exhaust nozzle sizes. This is possible because the locomotives are uniformly operated as to cut-off.

2—Elimination of water stops. The proper use of cut-off saves water and eliminates certain stops that are now occasionally made, requiring the maintenance of water supply stations that may otherwise be eliminated.

3—Uniform conditions of firing. Constant back pressure provides constant draft and firemen do not have to carry excessive fires in anticipation of a heavy pull on the fire because of the sudden use of long cut-offs.

4—Shock on reciprocating parts is lessened. As the pistons are opposed by a constant exhaust pressure, they are not subject to shocks where this pressure varies widely.

5—Lubrication protection in drifting. The back pressure gage is calibrated to register a vacuum; if in drifting the throttle is shut off only to the extent that no vacuum is created in the exhaust passages, no smoke box gases will be drawn into the cylinders to destroy lubrication.

6—Elimination of valve setting errors as they effect cut-off. It is difficult and practically never possible to set the valves so that the same quadrant notch on all engines of the same class will give the same per cent of cut-off. As the Automatic Cut-off Control adjusts the cut-off independent of any mechanical condition as to reach rod length, the proper cut-off is used regardless of errors of this nature.

7—Safety of operation. Many times on critical pulls the engineman is required to watch for signals, the brakes, the sand, the injector and the throttle to keep from slipping. A moment lost in handling the throttle and sand may cause slipping and stalling of the train.

Standards for Painting Cars and Locomotives*

Many Practices Which Have Been Successful Are Reported to Equipment Painting Division

As the committee was handicapped by circumstances which prevented meetings being held during the past two years it was, therefore, deemed advisable to submit reports as drawn up by individual members of the committee covering the various subjects and questions placed in their hands for consideration. Definite recommendations as a committee were withheld for the reasons stated. The subjects considered were twenty-four in number, part of which follow:

Subject No. 5—Finishing Interior of Steel Passenger Cars

B. E. Miller: The best method consists in providing a smooth surface in the usual manner and then graining it in imitation of natural wood. From the standpoint of appearance, mahogany is perhaps preferable, particularly if the surface, after having been grained, has had two coats of rubbing varnish and has been rubbed down to a smooth, dull finish with pulverized pumice stone and water or oil.

This method is expensive but it has its good points. For instance, a dull, rubbed finish does not show up finger marks or other blemishes nearly as conspicuously as one which has been allowed to go in gloss, in which case all varnish imperfections and particles of grit are bound to show up. Not only is the dull, rubbed finish pleasing to the beholder, but it is easily taken care of. The grained surface, because of its mottled effect and unevenness as to depth of colors, is also of help in obscuring blemishes incident to wear and use.

The maintenance of a grained surface is expensive because many portions of a car interior are subjected to severe usage. By friction and abrasions, varnish and graining color are removed in spots, exposing the ground color in a conspicuous manner. Spots of this kind cannot be touched up or hidden successfully. Frequently large panels have to be refinished in order to hide a comparatively small imperfection. This, perhaps, is as great a drawback to the system of graining car interiors as any and has caused many roads to adopt a cheaper practice by painting with opaque or solid colors.

A second method, though probably inferior to the grained surface, consists in surfacing up and painting in single or parti-colors, then varnishing and rubbing to a dull finish. Durability will be equal to method No. 1, though there are few who would not prefer to have the surface painted and grained. We have been used to natural wood on the interiors of cars for so many years, that for a while, at least, the public will cling to it until general usage has brought about a change of tastes.

A third and still cheaper method, though practical and durable, consists in painting with two coats of a durable enamel, the surface having previously been painted and smoothed up in the usual way. If the craftsman is careful in applying the material and avoids dirt or grit, a very acceptable appearance is provided. A dull appearance can be secured by rubbing with pulverized pumice stone and water or oil, which will also get rid of any gritty appearance or other conspicuous imperfections. It is very seldom done, however. This method is the cheapest of the three and for ordinary steel passenger car interiors is considered good enough by a number of roads. It is also to be preferred from the standpoint of maintenance, it being the easiest to touch up and keep in presentable shape.

It is difficult to decide which of these three methods is the best, as there is little difference in durability. As to appearance, there are few who would not have a preference for the grained surface and accept the other two methods in the order named. It then remains a question as to how far a road is willing to go to make its equipment attractive as to appearance.

Subject No. 7—Treatment for Steel Underframes

D. A. Little: The only effective thing is the sand blast, but as this is almost impractical owing to the fact that neither time nor opportunity is allowed, wire brushes are the next best thing to use. However, even this is not generally practiced for the same reasons. As a primer I would say that graphite or a good mineral paint similar to standard weight car paint is about the best and cheapest to use for this purpose, providing time and opportunity is allowed—otherwise, no, as it is only a waste of material and labor to paint over dirt and grease. I would say the same in regard to coal spaces and tops of tenders undergoing repairs. Of course,

*Abstract of the committee report submitted at the meeting of the American Railway Association, Equipment Painting Division, held at Chicago, September 4, 5 and 6.

the new tender frames and coal spaces are always painted.

W. H. Truman: The best method for removing scale and rust from steel underframes, where sand blast is not available, is to use a hammer made for the purpose with both ends sharp to crack the scale, then scrape with a scraper made from a file, then thoroughly rake with a wire brush.

The best primer for this class of work, after the surface has been thoroughly cleaned, is to apply one coat of princess metalic, mixed with ⅔ linseed oil and ⅓ spirits turpentine where time will permit, then finish up with one coat of lamp black ground in linseed oil or a good substitute oil.

Subject No. 8—Care of Ventilators and Deck Sash

C. A. Cook: It is becoming more and more evident that constant care is essential in connection with these parts of our steel passenger equipment if they are to be preserved from corrosion and decay even for a minimum period of service.

We know full well the importance of the initial treatment of these parts if the maximum life and service of the steel is to be secured. Assuming that the utmost care has been given the steel both in its preparation and protection, we can feel that it has been given a fair trial in its initial treatment.

The danger lies in allowing corrosion or rust to get a start. This can be avoided only by vigilant inspection. If rust is found at any point it should be removed thoroughly and the parts repainted. It is a safe course to confine inspection of these parts to the periodical shopping of the cars, but that at terminal points frequent inspection should be given.

The summary is, that the proper care of the ventilators and screens of steel passenger cars, lies in frequent and careful inspection, prompt removal of all rust or corrosion, and immediate protection by painting.

Subject No. 10—Prolonging the Life of End Structures of Express, Baggage and Mail Cars Constructed of Wood by Sanding

J. H. Kahler: The practice of sanding the ends of this class of equipment is a good means to prevent cinders cutting away the painted surface and exposing the wood to the elements. It is my opinion that a thick coating withstands cinders longer than a thin coating; also that if a material of a rubber-like nature were applied it would stand the wear of the cinders much better than the present practice of applying mineral paint and sanding. The sand of course retards the cinder cutting, but when the sand is cut away, the paint underneath perishes more rapidly, so that if this paint coating were of a rubber-like nature and if enough of it were applied, it would be an improvement over sanding, as the cinders would bound off without cutting off of the coating to any great extent. At least it would make a surface that could be cleansed whereas the sanded surface is hard to clean and it is difficult to remove the grease thrown up from the wheels.

Subject No. 18—Treating Tenders for Painting, Where They Have Been Cleaned with Washing Fluid

J. H. Kahler: To do this we use the material to suit conditions. If strong soap does not remove it we use weak lye and scrub into this with a palmetto fiber scrub brush, placed on a handle. Where conditions demand in different spots, we use also benzine and kerosene mixed, along with the use of a wire scratch brush. We try to keep ahead of the lye by the use of water in rinsing off frequently while cleansing; after it is dry a thorough scouring with emery cloth makes it ready to receive the painting.

Subject No. 21—Maintenance—Paint and Varnish on Locomotives

J. H. Kahler: I think it good practice to have one or more painters stationed at the enginehouse to repaint minor parts of the engine when held for repairs. Occasionally an engine is in long enough to give it a thorough cleaning and recoloring that makes it look "just out of shop." The cleaning of the engine proper should be done with an oil cleaner after grease and oil have been removed with kerosene and the oil cleaner must be thoroughly removed. The cistern is a different proposition owing to more or less sweating being present. Here I think it a good plan to wash off with weak soap and water and kerosene oil to remove all greasiness and grit and follow up with a varnish renovator.

The greater part of this kind of work should be done during the summer months as the winter months are not so favorable. Where there is no striping on engines this practice results in better appearance and protective qualities, but where striping is done on drivers, cab or tender, it is not possible to do this in so short a time and the result is the engine goes into service with a cleaned and touch up job, instead of a complete recolored appearance. This work can be done with varnish added to engine finish until the engine gets general repairs again.

Subject No. 23—Varnishing Locomotives by the Spray System

D. A. Little: I am opposed to the use of the spraying machine in varnishing surfaced work as the material will not flow out as nicely as when applied with the brush.

It is quite practical, however, to spray tender trucks, pony trucks and main engine frame provided you do not get into trouble with machinists who are working on the engines. They will not tolerate its use and from a hygienic standpoint I consider spraying paint wrong.

J. H. Kahler: I have never been in favor of applying varnish with the spray machine; being one of the first to use the spraying method and having tried the spraying of engine black to tenders, I draw the line at varnishing. We all know the most important operation in applying varnish is to get a perfectly even distribution, so that flowing will be exactly the same at every part of the surface. Then comes the careful wiping and slicking up to avoid sags and runs to insure a perfect surface. Can the spray machine accomplish all this? I have my doubts, when taking into consideration the difference between a clear liquid varnish and a mixed paint composed of oil and pigment which holds the oil in suspension, while the varnish has no pigment to rely on. I should want to follow up the spray machine with a brush if I were to spray varnish on a cistern covered with rivets in order to avoid runs or sags.

Subject No. 24—Painting a Locomotive and Parts Practical to Paint with Spraying Machine

J. H. Kahler: What the best methods are for painting engines is hard to determine, as the same rule could not be applied to all shops owing to climatic conditions, shop practice and shop conditions. I can only say how I would do the work with economy, at the same time considering durability and appearance.

We all know that a clean engine looks far better than one not cleaned. The main object is to paint them so that the cleaning may be done without much effort or expense; to bring this about the surfaces should be filled up smoothly and protected with enough varnish to make for durability. For economy's sake, all striping may be omitted. When we consider the hard life of an engine, out in all kinds of weather and the amount of dirt accumulation it picks up, it seems to me that durability should be the main factor, and the appearance would depend on the amount of cleaning done.

A durable smooth surface depends largely on the foundation, which in turn depends entirely on the priming coat which should be carefully prepared. In building up the surface care must be taken in handling the putty and glazing

coats in such a manner as to eliminate to a great degree the necessary cutting down to a smooth surface. On this surface one coat of flat color is to be applied and followed with one coat of varnish color. Lettering is to be placed on this coat and the surface given two coats of finishing varnish.

The spray machine can be used to great advantage and a saving in time and labor on such parts of locomotive as frames and spring rigging, brake rigging, engine trucks, tender trucks and frames and when boilers are to be painted before lagging is applied.

The Qualities of a Successful Foreman

Standing Between His Management and His Men, His Great Responsibility Is That of Leadership

By R. E. May
Car Foreman, Chicago & Eastern Illinois, Danville, Ill.

SUCCESS is not measured by the position one attains or the salary he gets, but by how well he is doing his job. Is he putting 100 per cent effort into the work? Is he using all the talents and knowledge he possesses in carrying it out?

A foreman to be successful should be of the highest type morally. He is the personal contact between the men he supervises and the company for which he works. The men form their opinions of that company largely from the type of man the foreman is. The public which is an important factor to be considered, also forms its opinion from its association with the local officers. The supervisors should, therefore, be in a position to command respect and confidence.

The foreman should have confidence in the company for which he works if he is to be in a position to inspire that confidence in others. If there is any one thing that needs developing and stimulating on the railroads, it is confidence. We have needed it in the past eighteen months in the training of new men and in developing in them a broader conception of railroading than a mere source of wages.

Next, the foreman should be considerate. He should have consideration for the company he represents, consideration for the public the company serves, consideration for the men he supervises, consideration for the other branches of the work in which he is not directly interested.

He should also possess knowledge, not only of his particular job, but of every phase of the business in which his company is engaged. This will give him a broader view and he will be better able to understand and serve his company. Of course, he should specialize on his particular job. He should have some definite plan in mind. In other words, he should always know what he wants to do, but he should not be afraid to ask questions and find out why things are done a certain way and why they cannot be done a better way. Big things are seldom accomplished by one mind. If he has an idea that is good, or that he thinks is good, then he should submit it to the test of criticism. If it stands the test, then the chances are that it is practicable. Knowledge is obtained in three ways, by reading the experience of others along similar lines, by getting the actual experience and by asking questions.

The bigger you measure up to your work, the easier you will find it and the swifter will be your progress in it. Foremen often become discouraged because they do not advance faster. They think they are being held back while someone else gets the coveted place. It is often said that the other fellow has a pull or is lucky. But in nine times out of ten it is preparation and knowledge that has put him ahead. The man who expects to win success without self-denial and self-improvements stands about as much chance as would a prize fighter in the ring without first having trained for the bout.

The foreman should have a spirit of co-operation. Working with others means not being afraid that you are doing too much and the other fellow is doing too little. A first-class man gives all there is in him because he knows that the most he can give is little enough. He never bothers about the possibility of contributing more than his share.

What the railroads are looking for and what they need is men who cannot become satisfied with themselves; men who consider what they have done as a fraction of what they could have done. Only a man of this type can truly co-operate and in order to get things done, there must be co-operation.

Most men are afraid of responsibility; they are willing to venture an opinion, but when it comes to deciding on definite action they like someone else to take the final step. It takes a lot of work and study to fit one to discharge a responsibility with accurate and positive judgment. When one assumes responsibility for a thing, however, he becomes interested, and he begins to get things done.

One of the greatest responsibilities of a foreman is that of assuming a personal leadership over his men in all matters affecting their attitude toward the company. In order to do this he must have a good knowledge of human nature. A foreman's task is to make every worker in his unit as efficient as possible. The achievement of this task makes it necessary to consider every one of his workers from the three points of view of capacities, interests and opportunities.

Capacities are those attainments of mind and body which a worker is able to bring to his work and which, if he chooses, he can exercise in its performance. It has been said that each one of us is a symposium of what he was born with plus what he has acquired through personal experience. Experience in this sense includes education and training. If it were possible to tabulate a list of man's capacities, it would probably include such characteristics as physical health, physical strength, eyesight, hearing, temperament, appearance, judgment, initiative, aggressiveness, thoroughness, disposition, education and general or specific knowledge.

Interests are the springs of action which make capacities work. When interest is co-ordinated with capacity, then the individual must of necessity become an efficient worker if he is given the opportunity.

This brings us to the third point. Opportunity does not necessarily mean opportunity for advancement, but opportunity to make use of the abilities with which he is endowed by inheritance, environment or experience. Now if we have a worker in a position where he has no opportunity to exercise his ability, then it is wasted so far as its benefit to the company is concerned.

It would be hard to find a man who is perfectly balanced with respect to these three fundamentals. If one had capacities suited to a certain kind of work and the opportunity

to exercise them, but lacked interest in that particular work, there is no need for me to tell you that he would not be efficient. You might compare him with a locomotive with its boiler, firebox, cylinders and pistons as capacities, which it can put to work to develop power, provided the fire and steam pressure are there also. Men are equipped with brains, eyes, arms, legs and health, capacities they can put to work provided they are quickened by the fire and steam of interest. I cannot emphasize interest too strongly because without it our capacities and opportunities avail us nothing.

It is a common failing with most of us to attribute to others the desires which actuate ourselves. If we go to the theater and see a good play, we tell others about it and want them to see it. The foreman must first himself be interested to arouse interest among the men he supervises. Men who have the interest, and opportunity, but lack the capacities, within a short time make more efficient workers than men who have capacities and opportunities, but whose interests were out of adjustment.

If a foreman has a man who has both capacities and interests, then he should provide him with an opportunity to exercise them to the fullest. If the man has capacities for some other branch of the work over which the foreman does not have jurisdiction, then he should confer with his superior in trying to place this man where he will be interested, contented and most useful to the company.

Possibly exceptions will be taken to these methods and it will be said that if a man doesn't want to work then he should be discharged. That was the old order of things, when the foreman discharged one or two men to put fear into the others. Men cannot work to the best advantage to themselves and the company through fear. Men must be led to believe that they are an important part of industry, the success of which depends on how well they do their work. Men should also be taught by the foreman that the company esteems them for more than what they produce.

A foreman should never make promises to his men that he cannot fulfill. He should be fair and just and when he is asked a question, no matter how simple it may sound to him, he should endeavor to answer it to the complete satisfaction and understanding of the one who asked it.

It makes no difference how much the management believes in a square deal for its employees or how much it believes in providing opportunity for advancement or in building men up to higher ideals and a broader conception of their responsibilities and service, if the foreman who has the direct supervision is not actuated by the same high standards, those of the management will avail nothing. The company, the same as the employees, will be the loser.

I do not mean to infer that a foreman should accede to every demand. But he should be in a position to defend and explain whatever action be taken. A foreman should defend the principles of the company and endeavor by word and action to endow others with the same attitude.

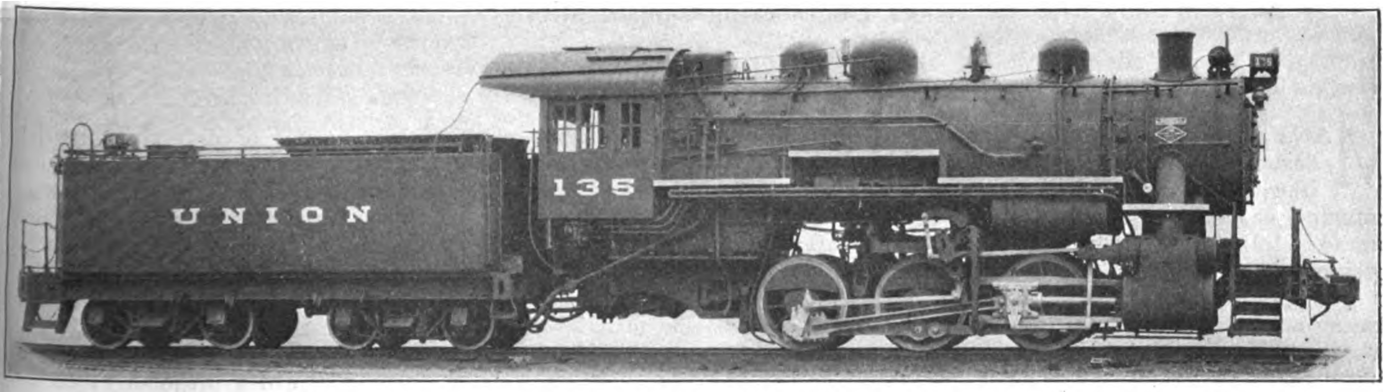
A foreman should be familiar with costs. He should know approximately the cost of a siding board, a flooring board, or any other material that is likely to be damaged by push cars or wheels when lying on the track or where other material is thrown on top of it and it is damaged so that it is not fit for further use. Bringing too much or the wrong kind of material out to a car, then leaving it to be thrown around until it is not fit to use should be avoided. If each employee knew that a certain item of material represents a certain sum of money and was impressed with that idea by his foreman, there is no doubt but that within a short time he, too, would manifest a like interest and within a year's time it would be hard to estimate the saving that would be accomplished. It is the mutual interests of employer and employee that brings about harmony and success. Too often we become used to seeing things done a certain way in the handling of material that we do not stop to realize the amount of money spent to replace it. If we were made the proposition of buying the material we use from the store department and paying for it in cash with the responsibility of having to make up any money that was mis-spent or spent for material not needed, I am sure we would practice more economy.

A Heavy Six-Wheel Switch Engine

An order of six-wheel switching locomotives has recently been delivered to the Union Railroad by the Lima Locomotive Works, Inc., which are heavier and more powerful than most locomotives of this type. The locomotives have a total weight of 182,000 lb., averaging about 60,700 lb. at the rail per pair of drivers, and develop a maximum tractive force of 42,900 lb.

In mechanical details the design is straightforward and rugged. Both as to cylinder power and boiler capacity, however, the locomotive is unusually large for this type. The cylinders are 22 in. in diameter by 28 in. stroke. The boiler, which has a total evaporative heating surface of 2,191 sq. ft. and 506 sq. ft. of superheating surface, is 72 in. in diameter outside of the front ring. It has 183 2-in. tubes and 28 5½-in. flues, which are 15 ft. in length over the tube sheets. It is of the straight-top type with the center line 9 ft. above the rail which, with the firebox set back of the drivers, gives a throat 19¾ in. in depth from the bottom of the mud ring to the bottom of the back barrel course. The firebox measures 77⅝ in. by 72¼ in. inside and has a horizontal grate 38.9 sq. ft. in area.

These locomotives are considerably larger than the standard six-wheel switch engine design of the United States Railroad Administration, but are not as heavy nor as powerful as the locomotives of this type operated by the Terminal Railroad Association of St. Louis which were built in 1916. Reference to the comparison of the principal dimensions and ratios of the three locomotives shows, however, that the Union



Heavy Six-Wheel Switcher Built for the Union Railroad, by the Lima Locomotive Corporation

Railroad locomotive has much the more liberal allowance of heating surface in proportion to the tractive force, although the proportion of firebox heating surface to total evaporating heating surface is considerably smaller.

COMPARISON OF SIX-WHEEL SWITCH ENGINES

Name of road	Union	U. S. R. A.	T. R. R. A. of St. Louis
Cylinders, diameter and stroke	22 in. x 28 in.	21 in. x 28 in.	22½ in. x 30 in.
Tractive force	42,900 lb.	39,100 lb.	45,500 lb.
Weight on drivers	182,000 lb.	165,000 lb.	198,000 lb.
Diameter of drivers	51 in.	51 in.	51 in.
Boiler pressure	190 lb.	190 lb.	180 lb.
Total evaporating heating surface	2,191 sq. ft.	1,886 sq. ft.	2,508 sq. ft.
Superheating surface	506 sq. ft.	442 sq. ft.	460 sq. ft.
Combined heating surface	2,697 sq. ft.	2,328 sq. ft.	2,968 sq. ft.
Grate area	38.9 sq. ft.	33 sq. ft.	41.4 sq. ft.
Tractive force x diameter drivers ÷ comb. heating surface	633.4	856.6	781.8
Firebox heating surface, per cent of evaporating heating surface	4.2	7.3	7.6

The tender tank is of the rectangular type and neither the tank nor coal pit is carried high enough to obstruct the vision to the rear from the cab. The tender frame is of the built-up type and is carried on arch bar trucks which are fitted with elliptical springs. The tender has a capacity of seven tons of coal and 7,000 gallons of water.

Interesting features of Union Railroad locomotives are the platforms to which access is obtained by side steps of the passenger car type, both at the front end of the engine and the rear end of the tender. The forward platform is placed over the front deck casting, with the steps placed immediately back of the cast-steel bumper, while the rear platform is carried on an extension of the underframe. Both the platforms and the running boards along the sides of the boiler are protected by railings of chain supported by columns placed along the outside of the running boards and the outer ends of the platforms.

The principal dimensions and data are shown in the following table:

Railroad	Union
Type of locomotive	0-6-0
Service	Switching
Cylinders, diameter and stroke	22 in. by 28 in.
Valve gear, type	Walschaert
Valves, piston type, size	11 in.
Maximum travel	5¼ in.
Outside lap	⅞ in.
Exhaust clearance	0 in.
Lead in full gear	1/16 in.
Weights in working order:	
On drivers	182,000 lb.
Total engine	182,000 lb.
Tender	127,200 lb.
Wheel bases:	
Driving	11 ft.
Total engine and tender	47 ft. 3¼ in.
Wheels, diameter outside tires:	
Driving	51 in.
Journals, diameter and length:	
Driving, main	10 in. by 13 in.
Driving, others	10 in. by 13 in.
Boiler:	
Type	Straight top
Steam pressure	190 lb.
Fuel, kind	Bit. coal
Diameter, first ring, inside	72 in.
Firebox, length and width	77⅝ in. by 72¼ in.
Arch tubes, number	4
Tubes, number and diameter	183—2 in.
Flues, number and diameter	36—5½ in.
Length over tube sheets	15 ft.
Grate area	38.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	145 sq. ft.
Arch tubes	18 sq. ft.
Tubes and flues	2,028 sq. ft.
Total evaporative	2,191 sq. ft.
Superheating	506 sq. ft.
Comb. evaporative and superheating	3,454 sq. ft.
Tender:	
Style	Water bottom
Water capacity	7,000 gal.
Fuel capacity	7 tons
General data and weight proportions:	
Rated tractive force, 85 per cent	42,900 lb.
Weight on drivers ÷ tractive force	4.25
Total weight engine ÷ comb. heat. surface	52.7
Boiler proportions:	
Tractive force ÷ comb. heat. surface	12.4
Tractive force × dia. drivers ÷ comb. heat. surface	633.4
Firebox heat. surface ÷ grate area	3.7
Firebox heat. surface, per cent of evap. heat. surface	4.2
Superheat. surface, per cent of evap. heat. surface	23.1
Tube length ÷ inside diameter	90

Methods of Sampling for Material Inspection

A Study of the Application of the Laws of Chance to This Phase of Engineering Specifications

By H. M. Phillips

MANY specifications for material which are carefully drawn in all other respects are either indefinite or illogical in the method of taking samples for determining the quality of the material offered and in the procedure to be followed when a portion of the samples fail to meet specification requirements. This statement applies not only to specifications drawn up by individual engineers or purchasing agents some of which are admittedly freakish; but also to those adopted by engineering societies and by the United States Government, which are generally regarded as "standard." In the following paragraphs no attempt will be made to establish a new standard; the field is far too broad. The generalities given below, however, may contain hints that will be of assistance to specification writers.

Character of Material Should Determine the Method of Sampling

In the great majority of cases it is obviously impossible to obtain absolute assurance that all parts or pieces of the material in question are of the same quality as the samples taken for test, perhaps the only exceptions being liquid or granular substances in which the entire mass is thoroughly stirred or mixed at the time of sampling. In all other cases the possibility of a certain amount of defective material escaping detection by sampling or taking test specimens must be recognized by the specification writer, who should determine to the best of his ability the expense for sampling and testing that will be justified in order to keep the amount of defective material that will escape detection down to a definite limit. It will readily be seen that in some cases the nature of the material or the process of manufacture insures a high degree of uniformity—either good or bad—in the product, allowing the acceptance or rejection of a large order on the results obtained from a few samples. On the other hand the order in question may be composed of the product of two or more different workmen, different machines, or different melts of metal, with the result that there are a considerable number of defectives either scattered through the entire lot or segregated in one portion of it. Unless the order can be divided into lots having the same characteristics, as determined by the factors noted above or by other causes, it is better to have the material so mixed as to avoid segregation. Otherwise it will be practically impossible to obtain correct samples of the material as a whole. Where segregation is likely to exist in a single specimen, as in a casting or in billets or sheets made therefrom, one or more samples should

be taken from the part where the injurious effects of segregation are most likely to be manifested.

Specifications should be so carefully worded as to leave no possibility of a misunderstanding in regard to the method to be followed in determining whether or not the material furnished conforms to their provisions; this necessarily includes the method of sampling. They should also show clearly the procedure to be followed or penalty to be incurred in case a portion of the samples fail to come up to specification requirements. If the specifications fail in this respect, which is not infrequently the case, the result is likely to be acceptance of unsatisfactory material or controversy and hard feelings between the parties concerned. Illustrations taken from specifications in common use showing lack of proper consideration in this respect may be of interest in this connection.

Specifications Often Vague

The term "representative sample" is not unlikely to lead to difficulties; when the run of the material in question is not perfectly uniform it may be difficult or impossible for the purchaser and manufacturer to agree upon what may properly be taken as a "representative sample." In many cases where a portion of the material is undoubtedly bad, it is practically impossible to secure a single sample that may fairly be called representative of the lot. Again it may be specified that the sample, or samples, shall be "selected" by the purchaser or his representative; which is a fair assurance, at least in the mind of the manufacturer, that he will pick what he believes to be the poorest specimen in the lot. This may be satisfactory in some instances, where each piece receives individual surface inspection in the process of manufacture; but it is obviously unfair to the manufacturer in others, as in the case of screws or rivets, where it is to be expected that there will be a few defectives in any large lot. In some cases this fault may be fairly well covered by allowing the manufacturer to withdraw any sample that he is unwilling to have tested; this may be considered as an individual rejection of the piece in question, a new sample then being selected by the purchaser. A sample "selected at random" may also be satisfactory in some cases, but certainly not in all. Perhaps 25 per cent of the material is defective, or shows some peculiarity in its appearance that causes the purchaser to doubt its ability to meet requirements; must the purchaser be content with one chance in four of obtaining a sample of this material? In fact the manufacturer might be within his rights in insisting that obviously defective material be allowed to remain in a lot of material from which a sample is to be "taken at random" and compel the purchaser to accept it if it did not happen to come up in the sample.

Laws of Chance Prove Many Methods Illogical

The question of the number of samples should be studied with regard to requirements of the individual case. When the order involves a considerable number of pieces such expressions as "one out of every ten" or "two out of every hundred" are in fairly common use, a method which may answer the purpose in some cases but is nearly always illogical. If we can assume that the various units composing the lot are of uniform quality, a single sample should serve for a lot of 1,000 as well as for a lot of 10; its application to material that is not uniform may best be illustrated by an example.

Let us suppose that 10 per cent of the total number of pieces in the lot are defective, and that the defectives are uniformly distributed throughout the lot. If the lot consists of but 10 pieces there is but one chance in ten of detecting the defective material by a single sample. With larger lots, and corresponding increases in the number of samples, the probability of obtaining at least one defective sample increases rapidly, as shown by Table I.

Much greater uniformity in the chances of detection of defective material would be obtained by taking a fixed number of samples, irrespective of the total number of pieces involved. This is illustrated by Table II. If the samples are destroyed in testing it would rarely be advisable to take five samples out of a lot of ten; for such a small number surface inspection of each piece and a single sample selected by the inspector would generally serve the desired purpose. It would seem well, however, to limit the maximum number of samples to a definite figure.

TABLE I—CHANCES OF OBTAINING DEFECTIVE SAMPLES FROM LOTS OF VARIOUS SIZES, WITH ONE SAMPLE IN TEN PIECES, WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE

Total number of pieces in lot	Number of samples	Number of chances in 100 of obtaining one or more defective samples
10	1	10.
20	2	19.4
30	3	27.9
40	4	35.5
50	5	42.3
60	6	48.4
70	7	53.8
80	8	58.7
90	9	63.1
100	10	66.9
120	12	73.5
140	14	78.8
160	16	83.1
180	18	86.4
200	20	89.1

TABLE II—CHANCES OF OBTAINING DEFECTIVE SAMPLES FROM LOTS OF VARIOUS SIZES, TAKING FIVE SAMPLES TAKEN IN EACH CASE, WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE

Total number in lot	Number of chances in 100 of obtaining one or more defective samples
10	50.0
20	44.8
40	42.7
60	42.1
80	41.8
100	41.6
200	41.2

Further Sampling After Failure of First Selections

Specifications are frequently indefinite or illogical in regard to the procedure to be followed when samples fail to meet specification requirements. In some cases the subject is not covered at all, leaving the purchaser and manufacturer to settle the matter as best they can *after* the inspection has been made. Sometimes the specifications require the material to be divided into lots of a definite number of pieces, one or more samples being taken from each lot and in case a sample fails, the lot from which it was taken is to be rejected. This procedure might be satisfactory if there was any strong probability of the different lots possessing different characteristics due to the process of manufacture; but in the majority of cases it may be assumed that the material has been pretty well mixed, either before or during the process of dividing into lots, and that therefore the different lots are of about the same average quality. If such is the case the lots that *chance* to be rejected on account of defective samples are probably no worse than the remaining lots from which the sample *happened* to be satisfactory.

In other specifications it is provided that in case of one or more of the original samples proving defective, additional samples shall be taken, failure of the latter to cause the rejection of the lot from which they were taken. Although this method appears fairly reasonable at first glance, it offers comparatively little protection to the purchaser, as may be seen from Table III.

The chance of rejection increases quite rapidly with the number of defectives. We may as an illustration assume that in a lot of 100 there are 30 defectives, the chances of obtaining one or more of them among 10 samples is 97.8 in 100, a practical certainty. The chance of final rejection if

2 additional samples were taken for each defective, failure of any to cause rejection, is 82.4 in 100, hardly as high as might be desired for such poor material.

Specific Cases

A well known specification contains the provision that the material shall be divided into lots of 250 each, two samples to be taken from each lot, two additional samples to be taken from the same lot for each failure of the first samples taken, in case of failure of any of the second samples the lots from which they were taken to be rejected. If 50 per cent of the material in a lot is bad there will be 75.3 chances in 100 of obtaining a defective sample; but only 59.7 chances in 100 of rejecting that lot through failure of the second samples. In other words if there were 2,500 pieces, half of which were bad, they would be divided into 10 lots, each of which would presumably contain about 125 good and 125 bad pieces. The probabilities are that six of the lots would be rejected and four accepted. If the percentage of defectives rises to 60 there will be 75.2 chances in 100 of rejection, but if it falls to 10 there will be only about 4 chances in 100 of final rejection.

TABLE III—CHANCES OF REJECTION WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE, ONE SAMPLE BEING TAKEN FOR EACH 10 PIECES AND TWO ADDITIONAL SAMPLES TAKEN FOR EACH ONE FOUND DEFECTIVE IN FIRST LOT

Total number in lot	Number of chances in 100 of final rejection
10	0
20	2.1
30	4.0
40	6.0
50	7.8
60	9.6
70	11.4
80	13.0
90	14.8
100	16.5

If a lot of 2,500 pieces contained 10 per cent of defective material and 20 samples were taken from the lot there would be 88 chances in 100 of obtaining at least one defective; while if 50 per cent of the material were bad there would be a practical certainty. If the nature of the material allows the acceptance of a lot with a considerable number of defective, provision might be made for acceptance with a limited number of defectives in the original 20 samples, but if the limit is exceeded the assumption is that the entire lot contains about the same proportion of defectives and should be rejected. For the protection of the manufacturer, he might be given the privilege of submitting additional samples, to be tested at his own expense, the material to be accepted if the percentage of defectives in the total number of samples is brought below the specified limit.

For example, if the limit were fixed at less than 10 per cent and two out of the original 20 samples were bad, 10 additional samples might be taken and if these were all good the material would be accepted; if two out of the 10 proved bad, 20 more might be taken and if these were all good we would have four defectives in a total of 50 and the material accepted. In the above illustration it is assumed that the manufacturer is compelled to submit samples in units of 10 in order to avoid fractional percentages. It would be somewhat easier for the manufacturer if, after the first rejections, he were allowed to submit a single sample and if that proved good there would be two defectives in 21 bringing the percentage below 10 and allowing acceptance.

Unless a large number of samples be taken there is always a probability that an occasional lot containing many defectives may escape detection and an equal probability that a lot containing a very few may be rejected. The manufacturer is naturally perfectly willing that the purchaser should assume the first risk, but is strongly opposed to assuming the latter himself. Specifications with a provision for retest reduce his risk to a minimum and somewhat increase the risk of the purchaser. By rights the purchaser should have the fullest protection because his payment for defective material is liable to prove a total loss and may in some cases involve a great deal of additional expense. The manufacturer who has good material rejected can usually dispose of it with little or no financial loss.

NOTE—The method of obtaining the results given in the preceding tables is simple, though somewhat tedious even when facilitated by the use of the slide rule, logarithms, or the calculating machine. As it will be advantageous for the specification writer to apply it to various specific cases an example of its use is given here.

Assuming a total of 60 pieces containing six (10 per cent) defectives, and six samples taken; the total number of combinations that can possibly be drawn, such as numbers 1, 2, 3, 4, 5 and 6; 1, 2, 4, 5, 6 and 7; 1, 3, 4, 5, 6 and 7; 2, 3, 4, 5, 6 and 7, etc., will be

$$\frac{60 \times 59 \times 58 \times 57 \times 56 \times 55}{1 \times 2 \times 3 \times 4 \times 5 \times 6} = 50{,}063{,}860 \text{ ....(1)}$$

To find the number of combinations that can be drawn without containing any defectives, assume that the 6 defectives are removed, leaving 54 pieces from which the possible combinations are

$$\frac{54 \times 53 \times 52 \times 51 \times 50 \times 49}{1 \times 2 \times 3 \times 4 \times 5 \times 6} = 25{,}827{,}165 \text{ ....(2)}$$

Subtracting (2) from (1), we have 24,236,695 ....(3) as the number of combinations that must contain one or more defectives. There are, therefore, 24,236,695 chances in 50,063,860, or 48.4 in 100 of obtaining defectives, as shown in Table I.

For the case illustrated by Table III it is necessary to determine the probability of obtaining a given number of defectives in the first draw. To find the chance of getting a single defective, determine the number of combinations of five non-defectives to which each of the six defectives may be added and multiply by six, thus:

$$\frac{54 \times 53 \times 52 \times 51 \times 50 \times 6}{1 \times 2 \times 3 \times 4 \times 5} = 18{,}975{,}060 \text{ ....(4)}$$

The ratio of (4) to (1) is 37.90 in 100 ....(5)

The chance of obtaining two defectives is the number of combinations of four non-defectives multiplied by the combinations of two defectives:

$$\frac{54 \times 53 \times 52 \times 51}{1 \times 2 \times 3 \times 4} \times \frac{6 \times 5}{1 \times 2} = 4{,}743{,}765 \text{ or } 9.48 \text{ in } 100\text{....(6)}$$

In the same way the chances of obtaining three defectives are:

$$\frac{54 \times 53 \times 52}{1 \times 2 \times 3} \times \frac{6 \times 5 \times 4}{1 \times 2 \times 3} = 496{,}080 \text{ or } .99 \text{ in } 100\text{....(7)}$$

and four are:

$$\frac{54 \times 53}{1 \times 2} \times \frac{6 \times 5 \times 4 \times 3}{1 \times 2 \times 3 \times 4} = 21{,}465 \text{ or } .043 \text{ in } 100\text{....(8)}$$

The chances of obtaining five or six are evidently too small to be considered. Adding (5), (6), (7) and (8) gives 48.41 as a total, which checks with the calculation for Table I.

Applying the same method to the second lot of samples, with two drawn on account of one defective in the first lot, the total number of combinations possible from the 54 remaining pieces are $\frac{54 \times 53}{2} = 1{,}431$; as there are now only five defectives in the lot the chance of escape is $\frac{49 \times 48}{2} = 1{,}176$, leaving 255 chances of rejection, or 17.82 chances in 100 ....(9)

There were, however, only 37.9 chances in 100 of obtaining the single defective in the first draw (5), so the total chance of rejection from this cause is 17.82 of this, or 6.754 chances in 100 ....(10)

The method of calculation of chances in (9) and in Table I may be somewhat simplified by figuring the chances of escape as a percentage and subtracting from 100 to obtain the chance of rejection; (9) then becomes

$$\frac{49 \times 48}{54 \times 53} = 82.18 \text{ per cent for escape and } 100 - 82.18 = 17.82 \text{ chances}$$

in 100 for rejection.

When four are drawn on account of two defectives among the first samples the chances of escape are $\frac{50 \times 49 \times 48 \times 47}{54 \times 53 \times 52 \times 51} = 72.82$ in 100, giving

$100 - 72.82 = 27.16$ chances in 100 of rejection..........(11)

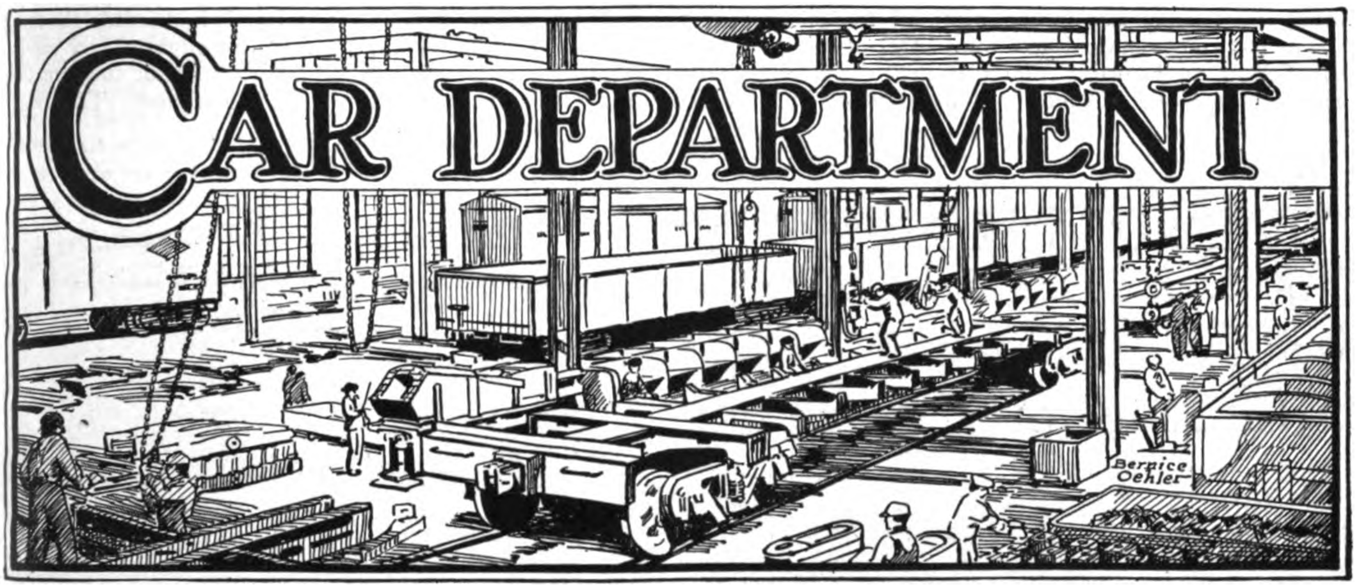
As the chances of obtaining two defectives in the first draw (6) are but 9.48 in 100, the total chance of rejection from this cause is 27.18 x .0948 = 2.58 in 100..(12)

Repeating the operation for six, we have:

$$\frac{51 \times 50 \times 49 \times 48 \times 47 \times 46}{54 \times 53 \times 52 \times 51 \times 50 \times 49} = 69.73 \text{ chances for escape and } 30.27 \text{ of}$$

rejections. There are, however, but .99 chances in 100 (7) of getting three defectives in the first drawing; which reduces the chance of final rejection from this source to 30.27 x .0099 = .300 in 100..........(13)

The chance in (13) has become so small that there is evidently nothing to be gained by going further. The total chances of final rejection through drawing either one, two or three defectives at the first trial becomes the sum of (10), (12) and (13) or 9.63 in 100, as given in Table III.

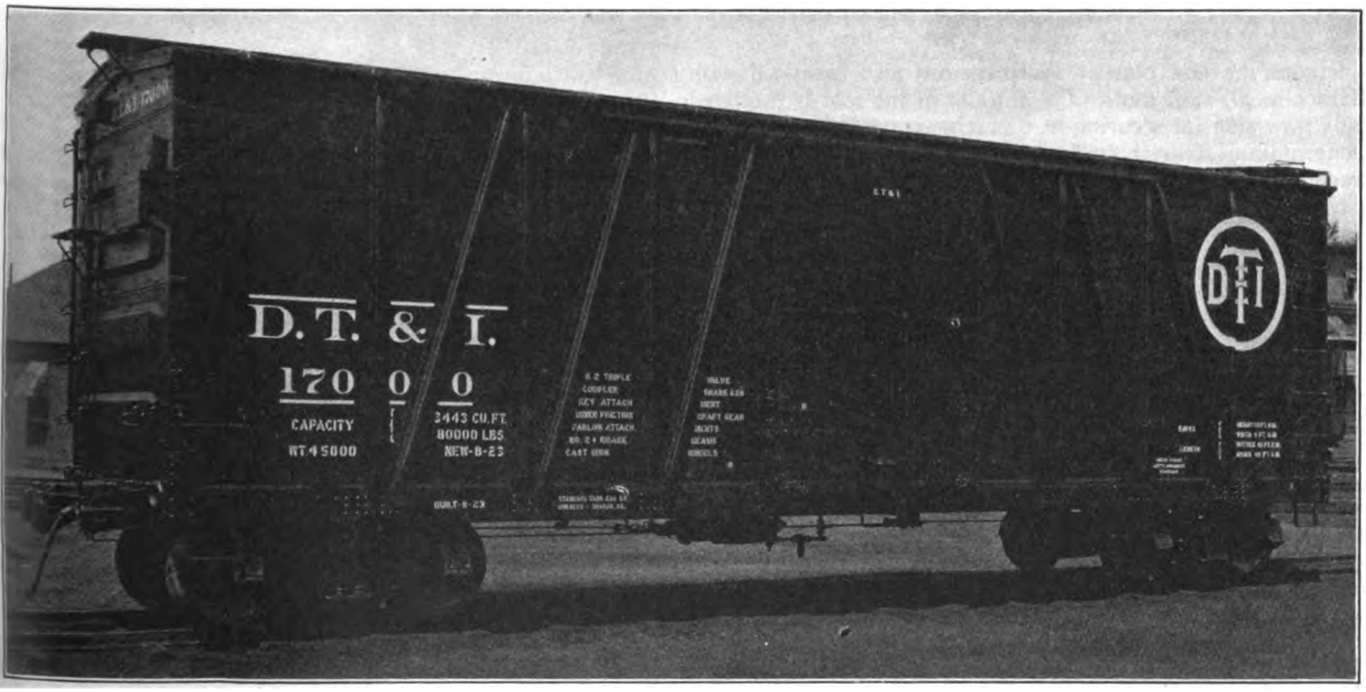


Single Sheathed Box Cars for the D. T. & I.

U. S. R. A. Design Modified to Provide One Foot Added Height and One Foot Wider Door Opening

LATE in 1923 the Detroit, Toledo & Ironton received 1,000 single sheathed box cars from the Standard Tank Car Company, Sharon, Pa., which follow very closely in the details of construction the United States Railroad Administration single sheathed cars, but have 12-in. greater clear height inside, and side doors 12 in. wider than the Administration design. These changes were made to adapt the car to the requirements of Ford Motor Company loading, and will permit the shipment of 16 Ford sedan bodies, double-decked, in one car load. The cars are 40 ft. 6 in. long by 8 ft. 6 in. wide and 10 ft. high inside. The doors have a clear opening of 9 ft. 6 in. high and 7 ft. wide.

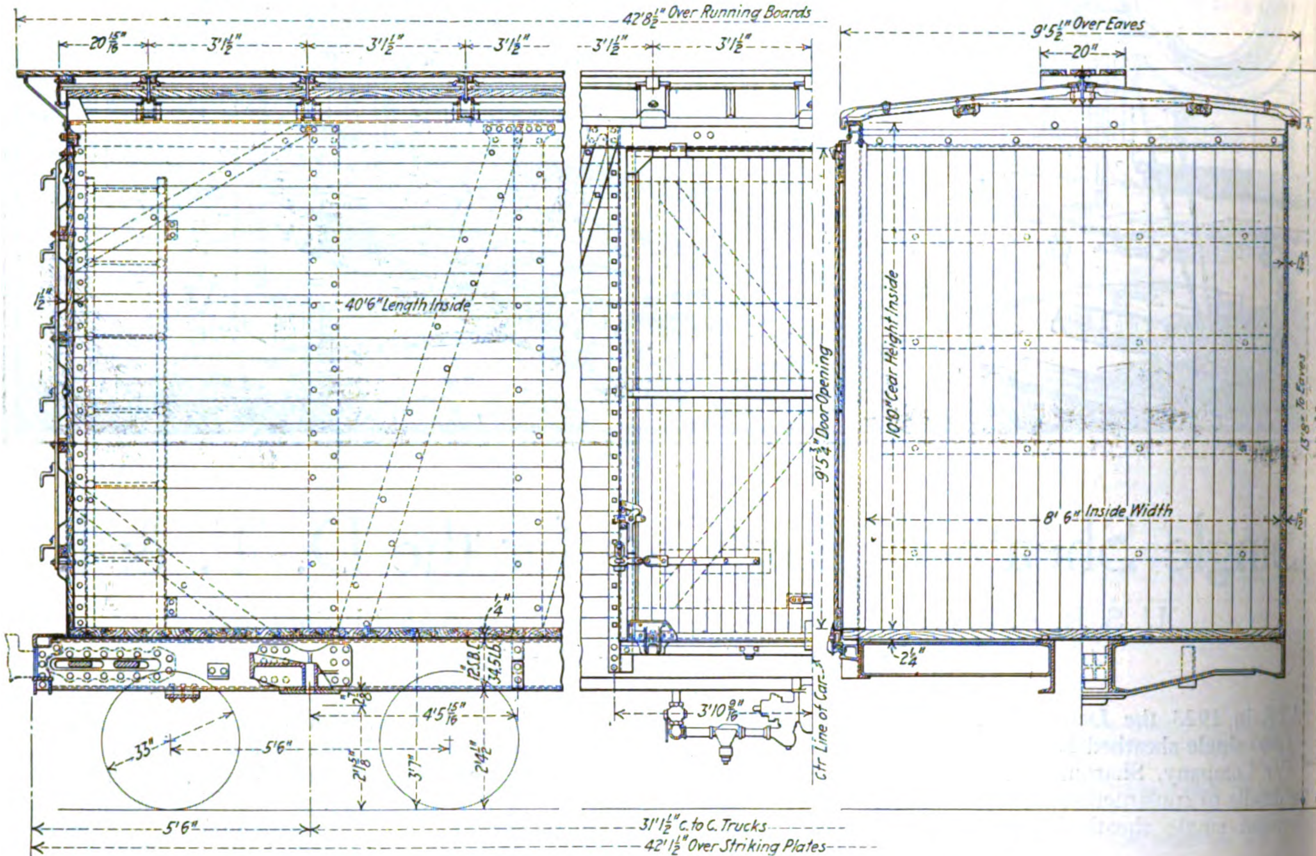
Like the Railroad Administration's cars, the underframe consists of two 12-in., 34.5 lb. shipbuilding channel center sills with two built-up crossbearers at either side of the door opening with pressed steel web members and cover plates, and built-up bolsters of similar construction. The side frame posts and braces are of pressed steel and differ from the Railroad Administration standard cars only in the reduced panel lengths between the bolster and door posts made nec-



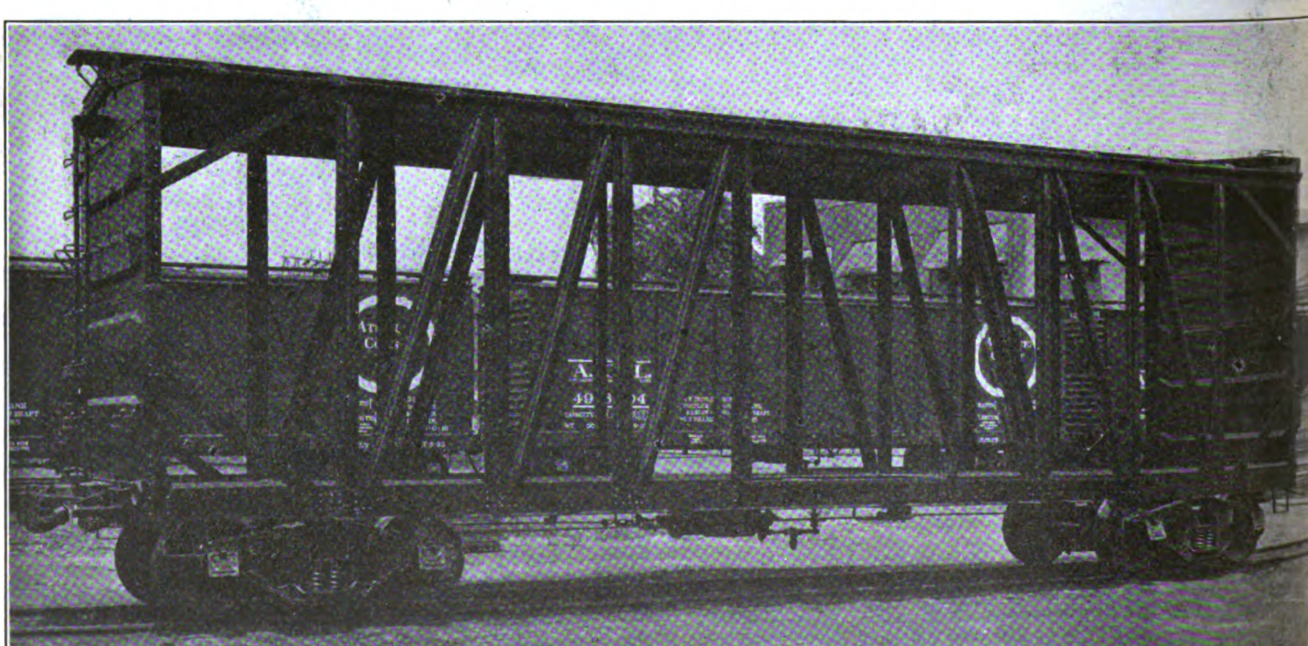
Single Sheathed Box Car for the Detroit, Toledo & Ironton with Door Opening and Height Each One Foot Greater than the U. S. R. A. Design

essary by the increase in the width of the door opening. The end construction differs from either of the three types specified by the Railroad Administration. It consists of the Hutchins two-piece channel type, the construction of which includes the end plates. The cars are also equipped with Hutchins all-steel roofs. The interior of the roof is protected and provision for securing load bracing is made by two heavy longitudinal strips bolted to the underside of the carlines, each about midway between the center and side of the car.

The floor, which is 2¼ in. thick, is laid inside the lining. The latter, of fir, is 1½ in. thick for slightly over one-half the height from the floor, above which point the remainder of the lining is reduced to 1¼ in. in thickness. The end lining, which is placed vertically, is attached to the steel end panels by four horizontal bolting strips, each of which is placed between the lining and the outward projecting channel portions of the steel ends. At the bottom of the car, the end lining is gained into the floor while the upper ends of the



Longitudinal and Cross Sectional Details of the D. T. & I. Single Sheathed, Steel Frame Box Cars

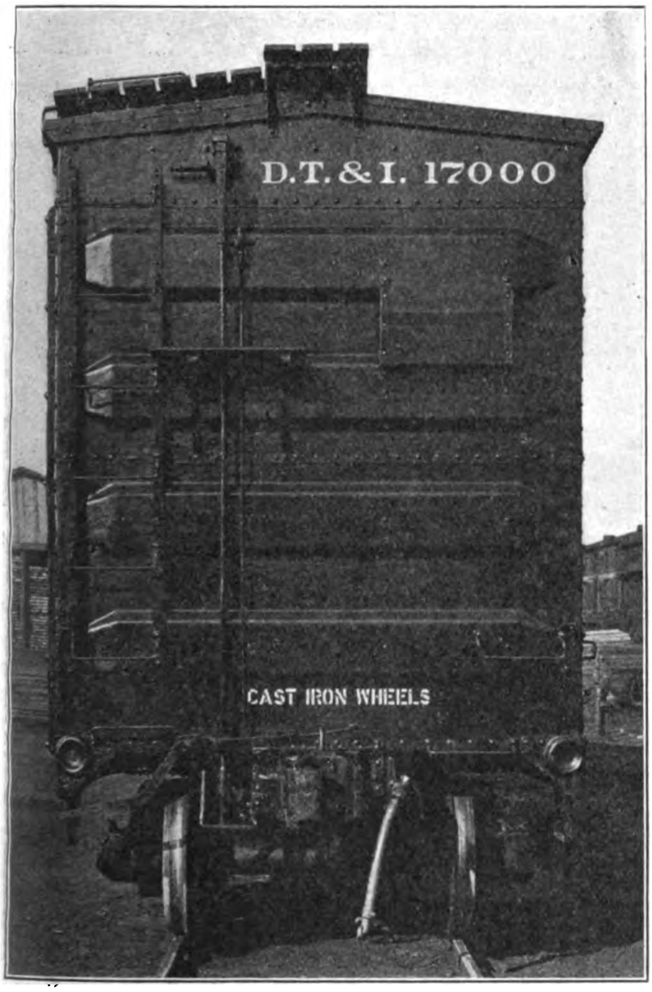


The Steel Frame and Roof Complete, Ready for the Floor and Lining

pieces are covered and held in place by a horizontal cap which is bolted to the end plate.

Like the Railroad Administration cars, the D. T. & I. cars have bottom supported doors, which are fitted with Camel No. 50 fixtures.

The trucks are of the Bettendorf type, with journal boxes cast integral with the side frames. Both the side frames and bolsters were furnished by the American Steel Foundries and bolsters are fitted with Stucki roller side bearings. The draft



End View of the D. T. & I. Single Sheathed Box Car

gears are of the Miner A-18-S friction type, with Farlow draft gear attachments. They are also equipped with the Carmer uncoupling device. The air brake equipment is operated by New York K-2 triple valves and the hand brake is the Miner Ideal lever type.

In appearance, the D. T. & I. cars differ from those of other roads in that the customary oxide red paint has been replaced by brown.

During the Year 1922 the American Railway Express Company handled more than 184,000,000 shipments, the average weight being approximately 80 lb. These shipments had to be handled at least once at the point of origin and at least once at the point of destination in addition to handling en route. To take care of the business in New York City alone, the company requires 655 motor vehicles and 900 horse-drawn vehicles. In Chicago it has in use 648 horse-drawn vehicles and 306 power vehicles, including 25 tractors and about 60 trailers. The total vehicle equipment throughout the United States and Canada consists of 2,636 gasoline vehicles, 1,195 electric street trucks, 324 electric industrial platform trucks, 100 semi-trailers and about 8,500 horse-drawn vehicles, a total of 12,755 units. The horse-drawn vehicles average approximately 12 miles per day; electric vehicles, 20 miles per day, and the gasoline vehicles 30 miles per day.

Handling Car Interchange in Cuba

By C. I. Mott

General Car Foreman, Havana Central, Havana, Cuba

For some time the railroads of Cuba have felt the need of a code of rules to govern the interchange of cars and the placing of responsibility for damage to equipment.

Since 1915, the United Railways of Havana, represented by the Havana Terminal Railway, had an interchange connection with the Florida East Coast through the medium of the car ferries operating between Key West, Fla., and Havana, Cuba. When this service was first inaugurated there was only one ferry a day with an interchange of 52 cars daily. At the present time the Florida East Coast has three car ferries and the daily interchange amounts to 100 cars. Since the beginning of this interchange of American cars in Cuba, the Havana Terminal has made bills for repairs to American cars, using the current A.R.A. rules.

Car Department Officers of the Cuban Railways Who Met to Consider the Adoption of the A. R. A. Rules of Interchange: Seated, left to right—Fernandez Lopez, general car inspector, Cuba Railroad; C. C. Hall, master car builder, Cuba Railroad; John Renfrew, superintendent coach car department, Havana Central Railway, Havana; C. Noya, master car builder, Norte de Cuba; C. I. Mott, general car foreman, Havana Central Railway. Standing, left to right—Rafael Sanchez, general air brake inspector, Cuba Railroad; Sr. Contrera, chief clerk to master car builder, Cuba Railroad; Sr. F. Vibarra, master car builder's clerk, Cuba Railroad; Mr. Weber, shop accountant, Cuba Railroad.

For some time the Hershey Railway, the Guantanamo & Western and the Norte de Cuba had, by common consent, tentatively employed the A.R.A. rules as a basis for handling their interchanges and for making repair bills. At the request of C. C. Hall, master car builder of the Cuba Railroad, a meeting was held at Santa Clara, Cuba, on May 8, 1923, for the purpose of eliminating from the A.R.A. rules those not applying to Cuban conditions, such as the safety appliance regulations and the regulations for the safe transportation of explosives, and of adopting the remainder for the use of all the railroads in Cuba. The modified rules were adopted by the car department officers at this meeting, subject to the approval of the general managers of the railroads involved. This approval has not yet been given.

At the present time, however, the 1921 A.R.A. rules are in general use by common consent, so far as the interchange of Cuban owned equipment between the Cuban roads is concerned. Repairs made to cars of American ownership by the island railroads are all handled under the current 1924 rules. As the Cuban railroads are not members of the American Railway Association, the Havana Terminal becomes the clearing house for all bills for repairs to American owned cars made by any of the other roads. These roads bill on the Havana Terminal, which in turn forwards the cards and bills to the Florida East Coast for collection.

Unique Car Building Contest on the B. & A.

Two Crews Tie for First Place by Completing Box Cars in a Total Time of 94 Man-Hours Each

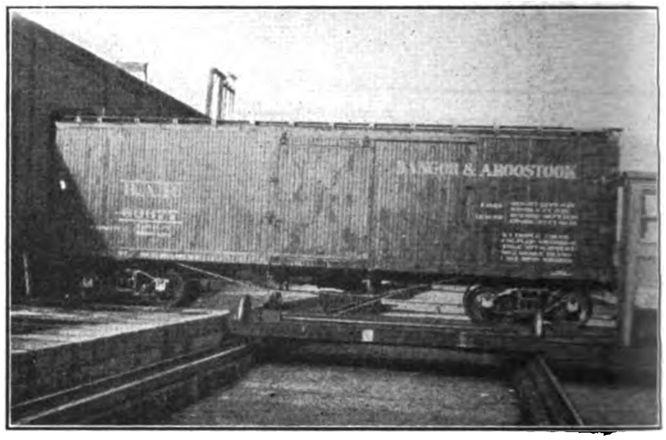
A CAR building contest was started in the Bangor & Aroostook shops at Derby, Maine, on December 3, 1923, between two of the best crews employed at the plant. The cars being built are of A.R.A. standard dimensions, with a steel center member construction of 32 sq. in. cross-sectional area, to which are attached four cast steel draft arms, two center plates riveted to the center member, four needle beams and two body bolsters, requiring the driving of a total of 344 rivets per car. Cardwell Type G-11-A draft gears with cast steel yokes were applied, using Type D couplers. The trucks are of the arch bar type, having steel bolsters, steel spring planks and 4½-in. by 8-in. journals.

Cars of Wood Body Construction

The superstructures of the cars are of wood construction and the frame members are of Southern pine and oak. There are two 5-in. by 9-in. side sills, two 5½-in. by 7¾-in. center sills and four 3½-in. by 9-in. intermediate sills, 36 ft. long, fitted in 8-in. by 9-in. end sills. In each body frame, including the end and door posts, there are 20 posts, 16 braces, the side and end plates, 9 carlines and 2 lines of belt rail.

The side lining consists of ⅞-in. by 3¼-in. hard pine sheathing, while the end lining, which extends to the end plate, is of 1¾-in. shiplap spruce flooring, the same material being used for the floor. The sheathing used is 13/16-in. by 3¼-in. material, both for the sides and the roof. The entire construction required 644 ft. b.m. for siding and 324 ft. b.m. for the roof. The latter is covered with a Chicago-Cleveland outside metal roof, requiring 28 sections of metal.

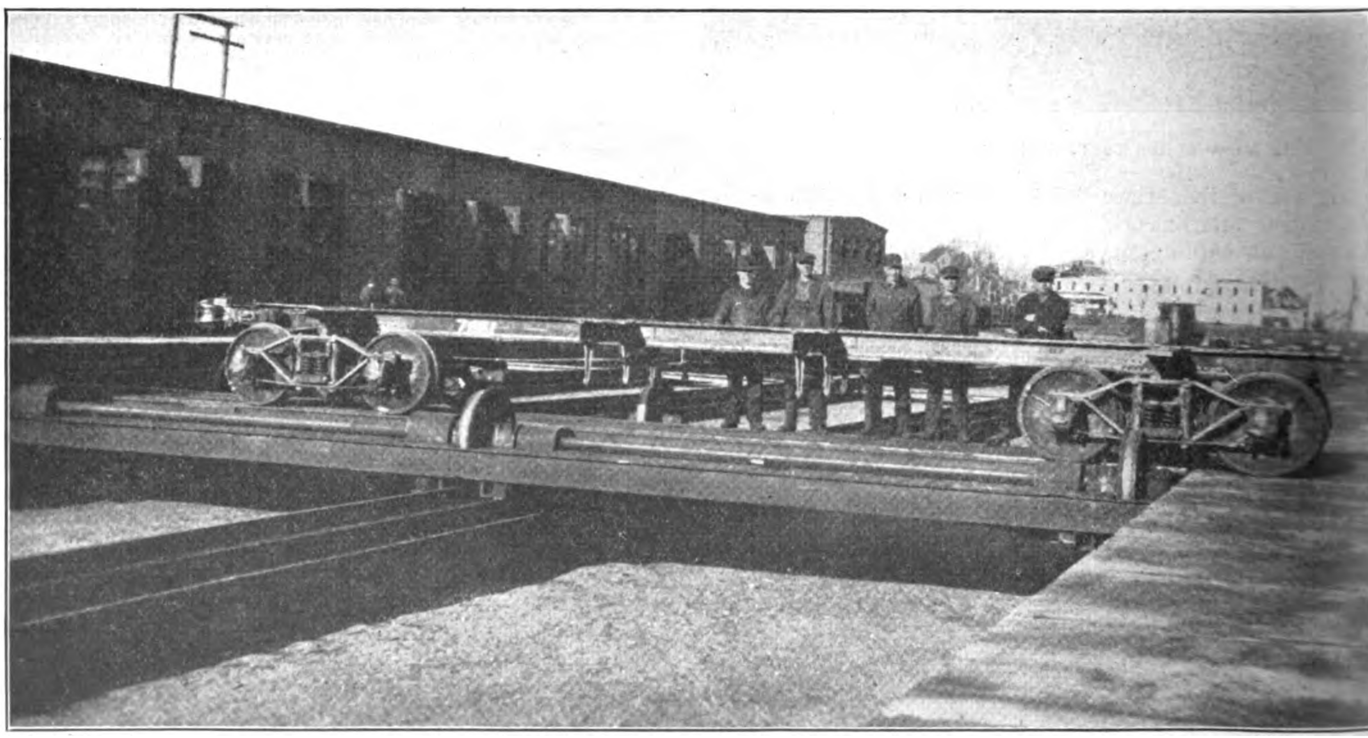
The first operation was the building up of the underframe and assembling of the trucks. The underframe work consisted of the attachment of the draft arms, the body bolsters, the needle beams and needle beam brackets, the brake cylinder bracket and the center plates to the center sills. The draft gear, yokes and couplers were also assembled and applied to the underframe. This work required the driving of 344 rivets, varying in size from ⅝ in. to ⅞ in. The time required for assembling the trucks was 2½ man-hours and for fabricating the underframe, 12½ man-hours, making a total of 15 man-hours for the complete job. The work was done by a gang of one foreman and four men, who are shown with the completed underframe and trucks in one of the illustrations.



B. & A. Car No. 60677 Was Built Complete, Including Paint and Stencilling, in 94 Man-Hours

Building the Superstructure

The building of the superstructure included the applica-



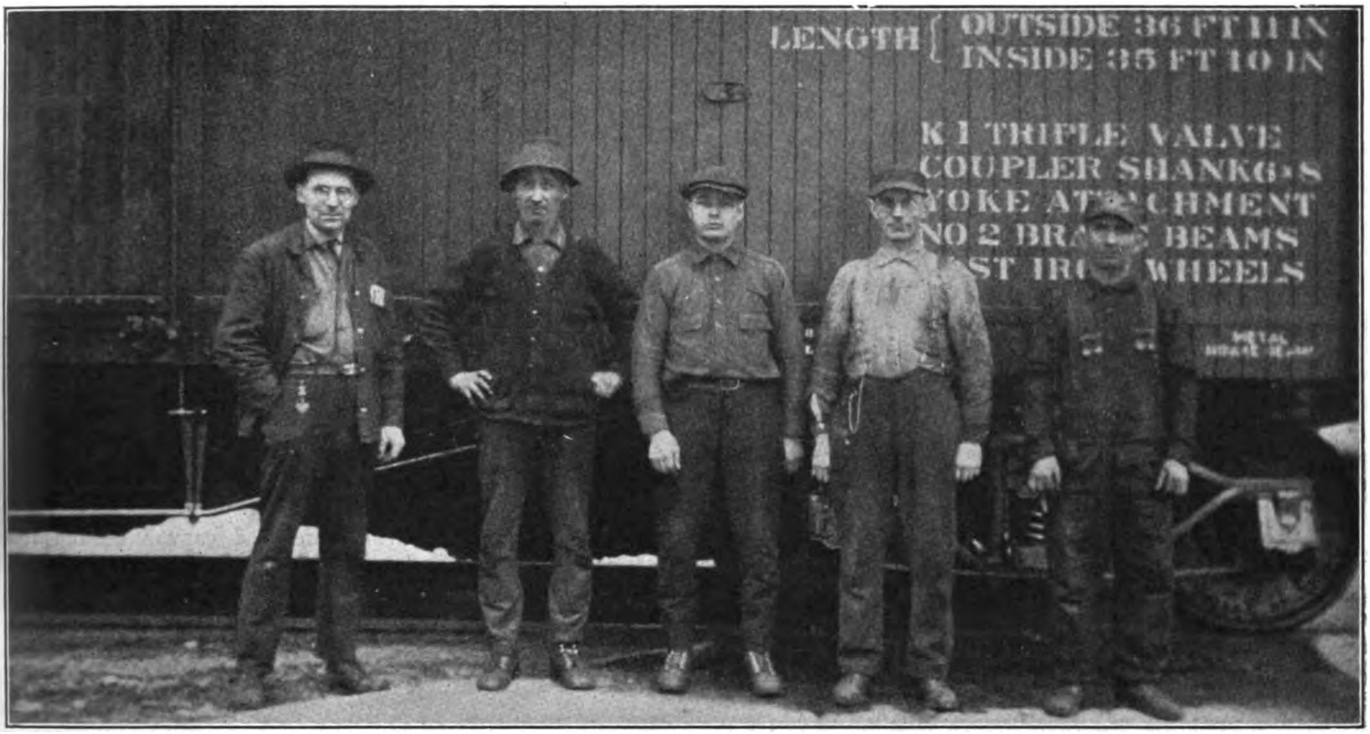
The Steel Underframe Was Built and the Trucks Assembled in 15 Man-Hours; Members of the Crew, from Left to Right are J. Foster, Everett Anderson, Lawson Dickson, Burns E. Grant and Clyde Barden, Foreman

tion of the wood sills, the body frame members, the inside lining, the sheathing and the roof, and was in the hands of another gang of one foreman and four men. The operations, however, were divided into three groups. The first consisted of assembling the sills, applying the flooring and erecting the body frame complete. This work required a total of 28 man-hours.

The next group of operations was made up of the application of the belt rails and the inside lining, leaving the car ready for the application of the sheathing and roof. These operations required a total of 14 man-hours.

Then followed the application of the sheathing and roof and the painting of the car, ready for stenciling. The woodwork was completed by the car men in 31 man-hours. Added to this was 1 hr. 50 min. for the air brake work and 2 hr. 40 min. for painting, making a total of 35½ man-hours, for this group of operations.

Two superstructure crews were entered in the contest. The



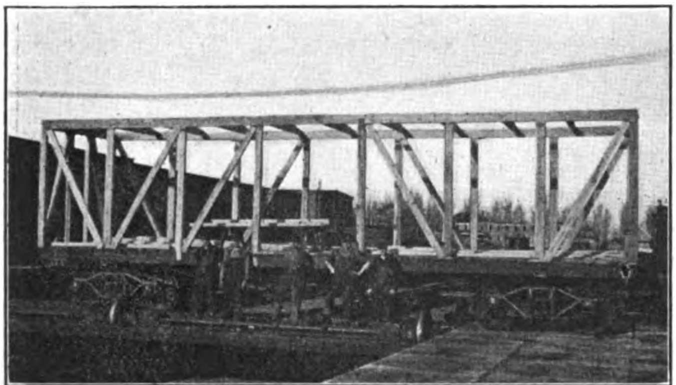
This Crew Built the Superstructure of Car No. 60677 in 73 Man-Hours—Left to Right: E. W. Bailey, Foreman; Murrell Harris, Alphonse Michaud, Charles E. Buswell and John Morrill

These Men Also Completed Their Superstructure in 73 Man-Hours—Left to Right: C. B. Godsoe, Foreman; Walter Chappell, S. Sherman Davis, Louis Cyr and Levi Robichaud

completed car for which the detail records are given, is shown in one of the illustrations. The complete time, including $1\frac{1}{2}$ man-hours for stenciling, was 84 man-hours. A summary of the time required for the different groups of operations is as follows:

	Man-hours
Assembling trucks	$2\frac{1}{2}$
Fabricating the underframe	$12\frac{1}{2}$
Applying the sills, body frame and floor	28
Applying the belt rails and lining	14
Applying the sheathing and roof, and painting	$35\frac{1}{2}$
Stenciling	$1\frac{1}{2}$
Total time to complete the car	94

The second gang, which built car No. 60672, completed its



The Wood Frame and Floor Was Assembled in 28 Man-Hours

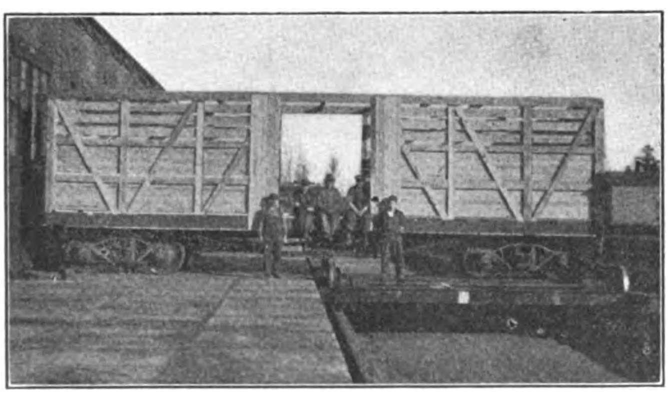
superstructure in 79 man-hours, including the painting and stenciling, or in 73 man-hours, exclusive of these items and the air brake work—the same total time as that required by the gang working on No. 60677. Each of the two cars required the driving of 6,308 nails, and the application of 360 bolts of various sizes.

The following is the bill of material that was used to complete each car

Flooring, 648 board feet	30-penny cut nails, 1336
Lining, 483 board feet	$\frac{5}{8}$ in. rivets, 56
Sheathing, 968 board feet	$\frac{3}{4}$ in. rivets, 100
8-penny nails driven, 3762	$\frac{7}{8}$ in. rivets, 188
10-penny wire nails, 1220	Bolts, miscellaneous sizes, 360

Conditions of the Contest

These two cars were taken from a series of 200 which were being built at the Derby shops. For their construction no special preparations or changes in methods of



The Application of the Belt Rails and Lining Required 14 Man-Hours

handling the material were made. All material was delivered to the tracks on which the different stages of the work were performed, and the man-hours recorded do not include the time of the laborers who delivered the material to the shops.

No special provisions were made for additional or extra facilities in completing this work. The trucks and underframe were assembled on one track and the superstructure completed on another, which was provided with a scaffold on each side at such height that workmen could take care of the top part of the superstructure without horses or other moveable staging.

The crew assembling the trucks and underframes was provided with an oil rivet heater and air hammers; the crews working on the superstructures were provided with air boring machines. Aside from these tools, no other machinery was used. The cars were mechanically painted and hand stenciled according to the standard of this road.

The shop in which these cars were constructed has a cement floor and all cars had to be moved from one track to another by transfer table. From the time the trucks were started, the cars were placed on three different tracks before being completed. The time required for these movements is not included in the record since none of the men employed in building the cars have any part in handling them to or from the transfer table.

Machine for Cutting "Mule Hide"

By W. W. Warner
Works Manager, Youngstown Equipment Company

A MACHINE for cutting prepared canvas roofing for passenger cars and cabooses, was recently built at the Kent, Ohio, shops of the Youngstown Equipment Company. The old method of doing this work was to roll the material out on the floor and cut it to the proper dimensions with

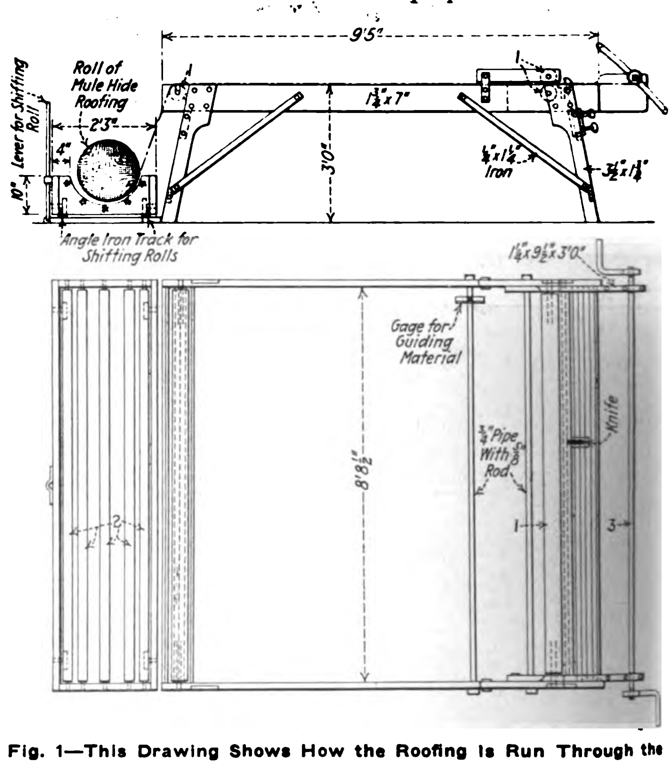


Fig. 1—This Drawing Shows How the Roofing Is Run Through the Machine

a knife. This method required considerable floor space, which was badly needed and also took a lot of time. The machine was devised to eliminate this difficulty and since it has been in operation, the work can be performed more easily and in less than half the time formerly required for cutting canvas roofing.

As shown in Fig. 1, the roll of roofing is placed in the cradle carriage at the left end of the machine. This carriage is equipped with rollers so that the roll of material will revolve easily. The cradle is placed on four small rollers that

run on an angle iron track so arranged that the carriage can be shifted back and forth. Because the material is not evenly rolled, it is necessary to shift the roll in order to keep it against the guide, which regulates the width of the strip that is to be cut. The roofing is drawn up over the top roller at the left end of the frame and thence across to the right end and passes between the two wooden rollers at 1, Fig. 1, and continues through to the roller marked 3. A handle is attached at either end for rolling up the material that has

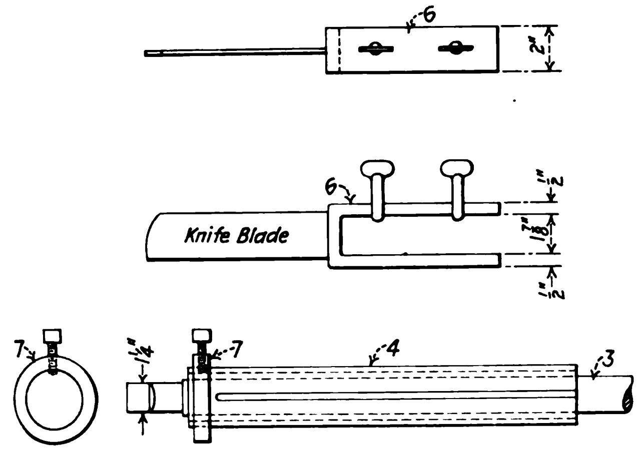
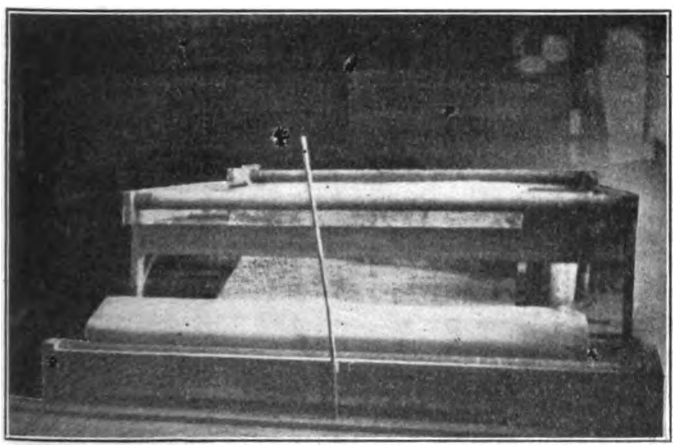


Fig. 2—Detail of the Knife, Showing the Manner of Attaching It the Machine

been cut. The scrap material can be rolled on another sleeve or allowed to drop to the floor. The large pieces can be saved for repair work or otherwise disposed of.

A loose sleeve is placed over the roller, 3, Fig. 1, to take the end of the strip in order to hold the roofing while it is being wound around the roller. This loose sleeve is fastened to the roller by means of a set screw. Sleeves of different lengths are furnished, depending on the width of the material that is required. The knife, Fig. 2, is adjustable and is fastened by means of set screws to a bar on the right end of the frame so as to cut the material as it comes from between the two rollers. If the material furnished is wider



A Roll of "Mule Hide" Being Run Through the Cutting Machine

than required, two knives can be used so that two strips for the sides of a passenger car roof can be cut at one time as the operator may desire.

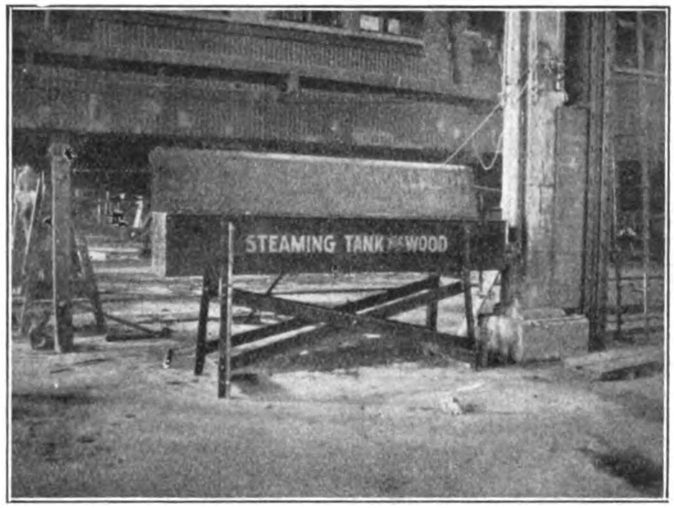
By measuring along the surface of the material at the top of the frame, the length can be ascertained as it is being wound up. After the roofing is cut to width and length, and then rolled, the set screw which locks the sleeve on roller 3, Fig. 1, is loosened and the roll removed. It is then ready to be taken to the car, where it can be unrolled and applied.

Steaming Tank for Wood

By Michael Piasecki

Assistant Carpenter Foreman, Chicago, Milwaukee & St. Paul, West Allis, Wis.

THE illustration shows a device that is being used successfully in the coach shop of the Chicago, Milwaukee & St. Paul, at West Allis, Wis., for the purpose of bending wood to be used on the hoods of passenger or express cars and



A Handy Device for Coach Shops

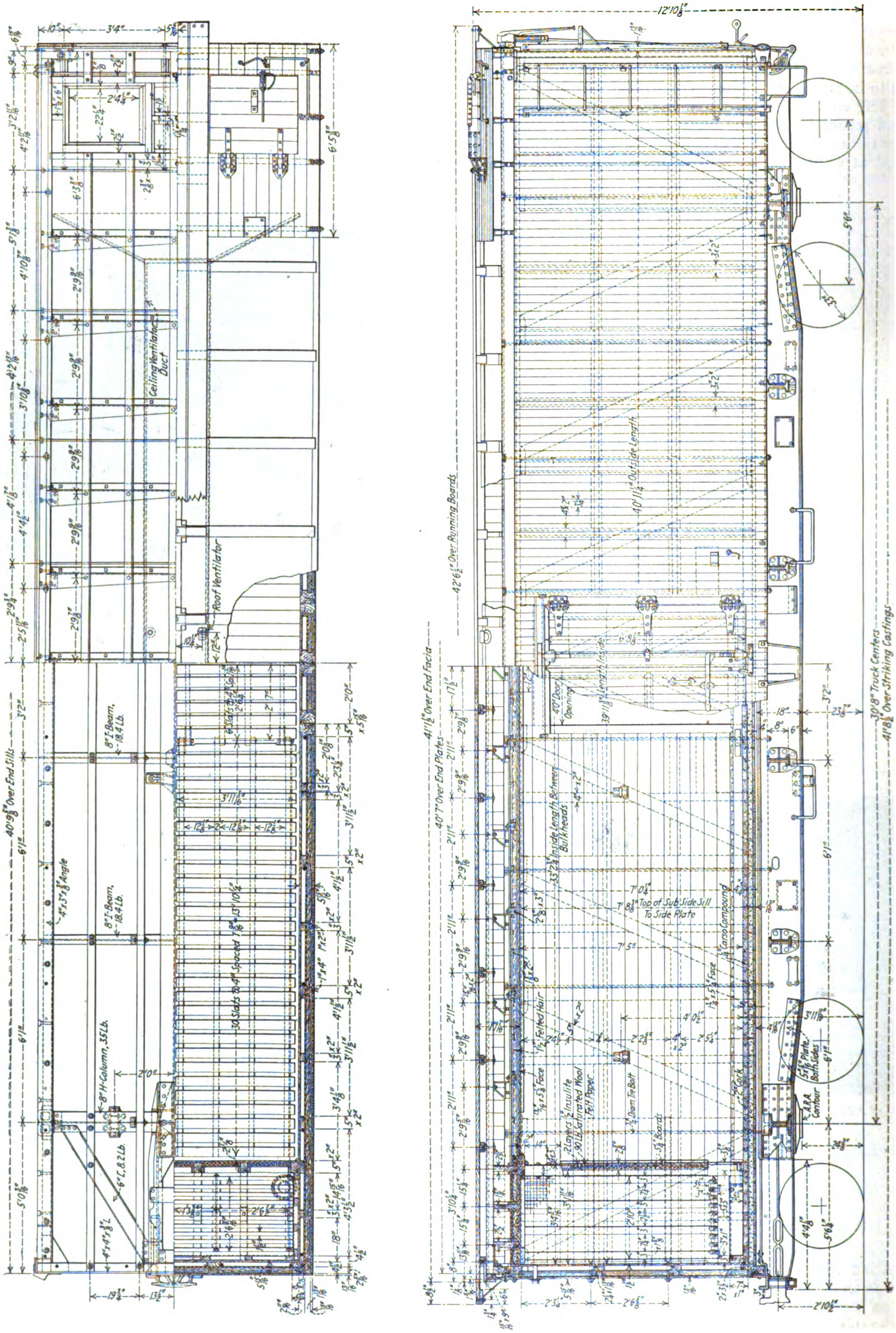
also for bending the molding used to hold the glass in oval windows. All of this work was formerly done by hand, and as a result 75 per cent of the roofing material would break while being applied. This wasted considerable material and required 16 hours of labor to complete a job of this nature on a car roof. Since this device has been placed in service the material formerly wasted has been saved and the amount of time formerly required has been reduced to five hours.

The device consists of a tank which is constructed of No. 10 gage iron. The frame is made of heavy 2-in. angle irons well braced and securely riveted. A ¾-in. perforated steam pipe for supplying the steam is run the entire length of the tank. After placing in the tank the wood that is to be bent the steam is turned on for 20 minutes. At the end of this time the material is ready for bending.

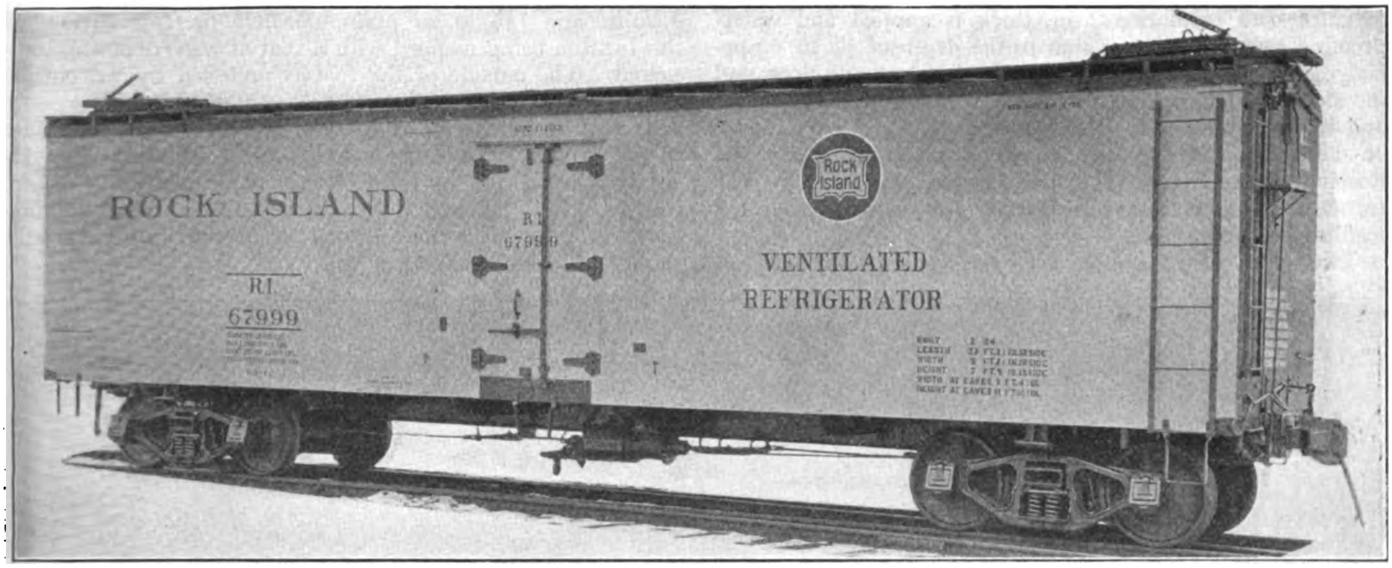
Standardization of industrial production has been one of the important factors in enabling Germany to maintain its industrial machine intact, in the face of the multitude of obstacles now confronting that country, states a recent bulletin of the American Engineering Standards Committee.

An example is cited of the efficiency of national standardization as it has been developed in Germany, in the case of a rush order placed with German manufacturers for 200 locomotives for delivery to Russia. Production of different parts was allotted to 17 different manufacturers to be produced strictly upon the plan of interchangeable parts, no one manufacturer making a complete locomotive. The inspectors made a striking test of the feasibility and accuracy of the plan by ordering a complete locomotive to be assembled from parts chosen at random from the parts furnished by the 17 manufacturers. It proved to be ready for service immediately after assembly without the necessity of any disassembling for readjustment.

Standardization engineering is now said to be a recognized profession in Germany. The rapid development of standardization organizations within the companies has made a large demand for such work. An interesting development of the last few years is the appearance of consulting engineering firms specializing in standardization work. There are now five such firms in Germany.



Side Elevation and Plan Drawings Showing the Detail Construction of the Rock Island Refrigerator Car

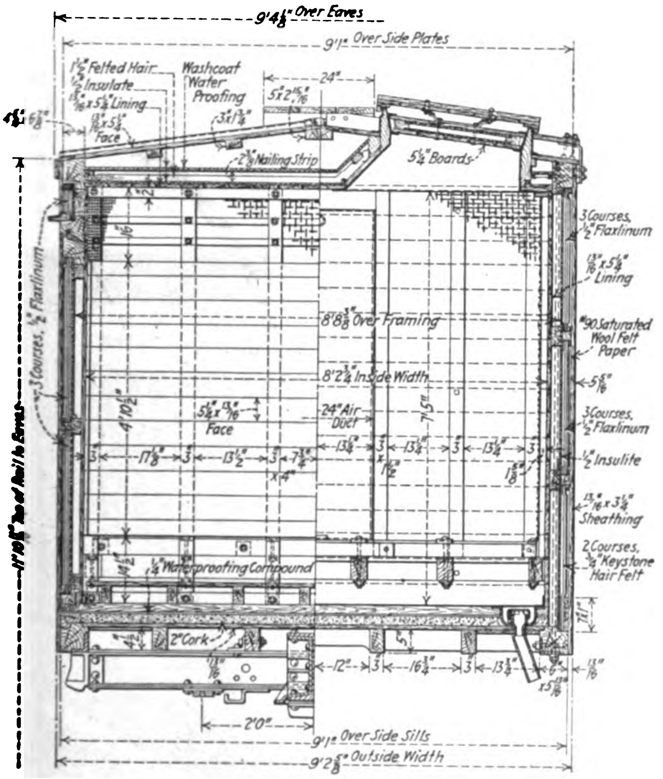


New Refrigerator Car Built for the Rock Island by the General American Car Company

New Refrigerator Cars for the Rock Island

Improved Side Construction Has Reduced Maintenance Costs and Improved Refrigerating Efficiency

An order of 250 refrigerator cars has recently been delivered to the Chicago, Rock Island & Pacific by the General American Car Company, Chicago, Ill. These cars are being placed in regular service as soon as received



Cross Section of the Car Showing the Method of Insulating

nd represent additional new equipment that the Rock sland has purchased to improve the quality and amount of ts refrigeration service to patrons shipping fruit, vegetables nd other perishable food products.

The designers have incorporated in the cars a number of new features in the method of insulating the outside of the car and in the system of ventilation. The usual dimensions used in building refrigerator cars in recent years have been followed throughout. The height from the rail to the top of the running board is 12 ft. 10 1/8 in. The end sills are built flush with the ends of the car and the distance over the striking castings is 41 ft. 8 1/2 in. The inside length between the bulkheads is 33 ft. 2 3/4 in.

Insulation Massed Together

The new refrigerators are equipped with Bettendorf trucks and underframes; the superstructure is of wood and the outside roof of steel. Particular attention has been paid to getting maximum efficiency from the insulation, and, in line with recent investigations, it was decided to mass the insulation material rather than apply it in layers with air spaces between. Experience has shown the difficulty of keeping the walls of dead air spaces tight in movable structures such as refrigerator cars, and unless these walls are tight so as to prevent all circulation of air, the effectiveness of the air spaces as an insulating medium is largely destroyed.

Massing the insulation on the outside of the car also simplifies repairs, and is a particular advantage in case the car is side swiped and the sheathing and insulation damaged without piercing the inner lining. Repairs can then be made much more easily than if the insulation is split, part being on one side and the remainder on the other side of the posts.

Another advantage of massed insulation on the outside of the car is that it permits the location of the side framing about 2 in. in from the edges of the sills, thereby giving a stronger construction and one which provides less possibility of the post and brace castings being crowded out by a bulging load.

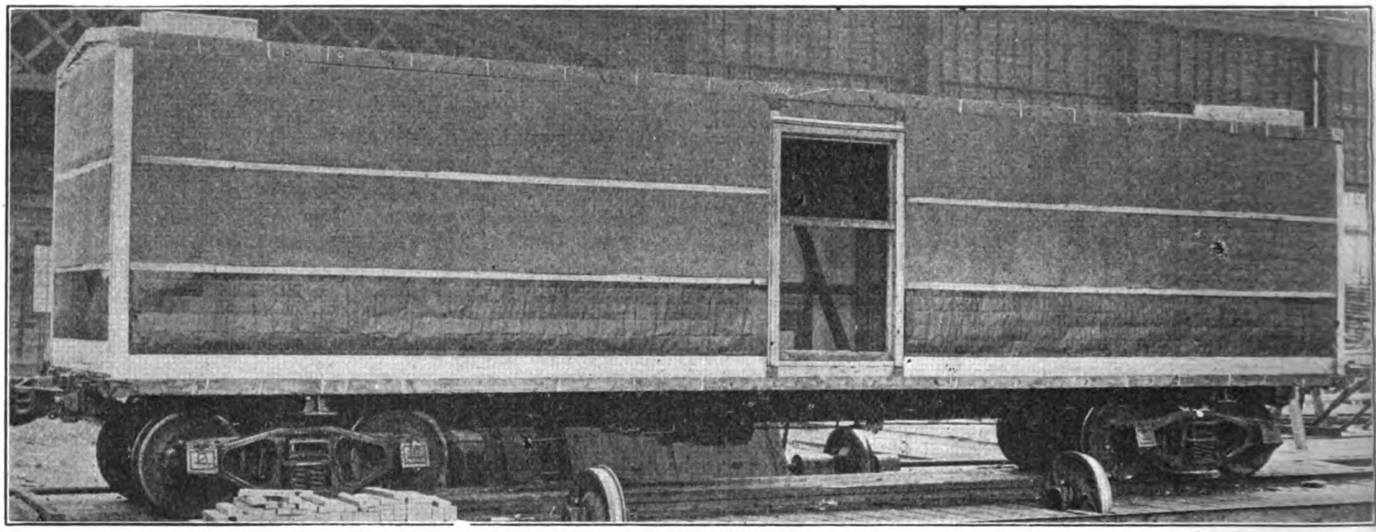
Reference to the drawing, which is a cross section through the center of the car, shows in detail the insulation used on floors, sides and roof. Above the 13/16-in. blind floor a

layer of cork insulation 2 in. thick is applied and waterproofing compound covers that to the depth of ¼ in. Special care has been taken at the sides between the floor and the side insulation to fill this space with insulating material and to waterproof it so that even though water be standing on the floor of the car it cannot get down at the end of the flooring to cause rot. The main flooring, 1¾ in. by 5¼ in. face, is applied over a layer of paper on top of the insulating material.

Two types of insulation are used on the car sides as indicated in the drawing and one of the photographs. One layer of ½-in. Insulite covers the entire side of the car, taking the place of the usual ⅜-in. blind lining. It is applied next to the posts and braces. This adds considerably to the stiffness of the side walls. The car sides up to the lower belt rail are covered with two courses of ¾-in. Keystone hair felt. Three courses of ½-in. Flaxlinum are applied to the car sides above the lower belt rail. The car doors, shown in cross section on the left of the drawing, are also insulated with one layer of ½-in. Insulite and three courses of ½-in. Flaxlinum.

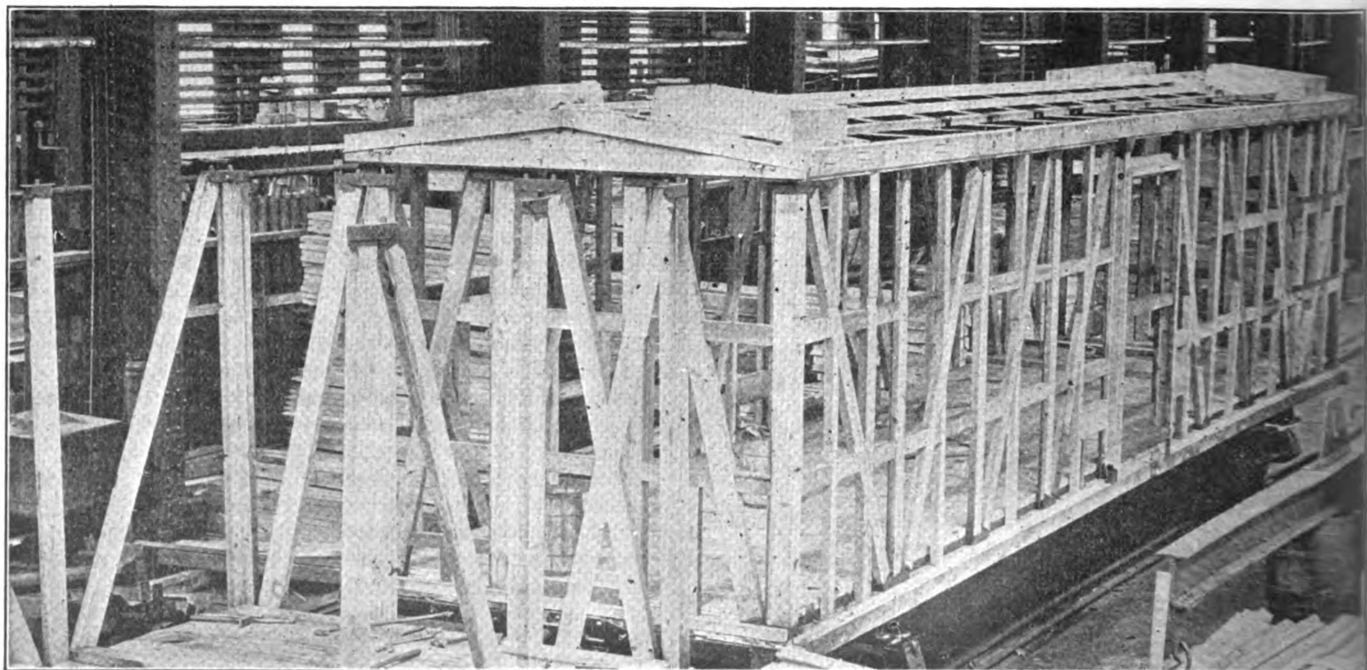
The roof is thoroughly insulated with two courses of ½-in. Insulite and 1½ in. of plain hair felt, the top surface of the Insulite being mopped with a coat of waterproofing compound. The outside of the roof is protected by an outside metal roof.

It will be noted from the above that the floors and sides of the car have the equivalent of four ½-in. courses of insulation while the roof has the equivalent of five ½-in. courses. It is believed that this car will be found to compare favorably with other high class refrigerator cars built recently for similar service.



Two Courses of Hair Felt Are Used Up to the Belt Rail and Three Courses of Flaxlinum Above

Basket-type ice bunkers are used and the hatches are of the Emerick design, which permits of more easily filling the ice boxes to the top. The Sessions type K-4 draft gear is used on one-half of the cars and the Miner class A-18-S draft gear on the remainder. All of the cars are equipped with Farlow draft attachments, Chicago-Cleveland Mullion type outside metal roofs, Klasing hand brakes, Kass safety tread steel brake steps, Miner door fasteners. The side and end ladders are made by the Wine Railway Appliance Company. The car is also equipped with floor racks which can be turned up against the side of the car for cleaning or when handling ordinary freight.

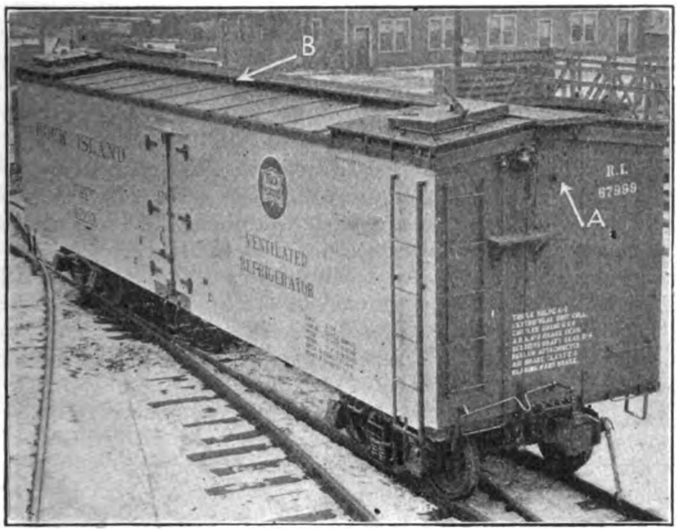


This View Shows the Flooring, Insulation and Method of Applying the Roof

Several operations in the construction and assembly of these cars are clearly shown in the illustrations. One view indicates how the posts and braces are erected, and how the roof, assembled on the floor as a unit, is applied on top. Another view shows the different insulation above and below the lower belt rail.

Acme Ventilation System Used

Another feature of the new Rock Island cars is the ventilating system, developed by the Acme Refrigerator Corporation, Chicago. This system, a description and drawing of which appears in the August, 1920, number of the *Railway Mechanical Engineer,* is not new having been first applied to an experimental refrigerator car in 1920. The correctness



An End View of the Car, Showing Some of the Specialties; (A) Is the Inlet and (B) the Outlet of the Acme Ventilating System

of the principle involved has been demonstrated in subsequent applications to other refrigerator cars, cold storage rooms and Rock Island dining car refrigerators, on which it is standard.

The Acme System is designed to allow gases, heat and moisture from perishable food products to escape by means of two small ventilators in the top of the car without interfering with the normal processes of refrigeration and air circulation in the car. In the usual construction these gases are found stratified in the upper part of the car close to the ceiling and because of their less density they can be eliminated by the proper means at the highest point. Gases from the food products are said to have a strong affinity for water vapor, and therefore in escaping carry with them a considerable amount of moisture which would otherwise promote decay. The result is a strong tendency to prevent moisture and mold from forming on such products as meat, vegetables, berries, etc., when these are shipped long distances.

As applied to the Rock Island refrigerator cars this ventilating system consists essentially of two units, one for gathering and discharging the gases mentioned, and one for equalizing atmospheric pressure and admitting enough air to balance that which escapes. One inlet *A* (shown in one of the illustrations) is provided in each end of the car, and there are two ventilators or outlets, one of which is shown at *B*, under the running board near the center of the car.

The gathering unit consists of a shallow galvanized iron ceiling duct, open at both ends near the ice bunkers at points where the gases are said to reach their highest temperature and exert the greatest pressure. Atmospheric pressure, having been equalized at a lower point, the gases pass through the ceiling duct toward the center of the car and are thence allowed to escape through the ventilators. These ventilators are slightly off center with respect to the center line of the car and the openings to them from the ceiling duct are staggered so as not to present too direct an opening to the atmosphere.

To equalize atmospheric pressure and supply an equal weight of cold air, the inlet *A* is connected to a shallow metallic air-tempering can, secured to the end lining of the car back of the ice bunker and extending nearly to the drip pan. The air from the outside entering this can and traveling downward precipitates its moisture on the cold metal, and is pre-cooled so that it enters the car both dry and cool. The small volume of air entering indirectly is thus automatically controlled by the elimination of gases and water vapor by natural means.

The result of the operation of this ventilating system is said to be the elimination of gases and excess moisture, thus tending to provide a circulation of cold, dry air which is most effective in preserving perishable food products. Keeping the interior lining and insulation dry will also have a tendency to prolong the life of the car. In view of the number of Rock Island refrigerators which are to be equipped with this ventilating system it will be tested under practically all kinds of service conditions. The results of these service tests and the extent to which they substantiate claims made for the system will be watched with interest by railroad men in both the operating and mechanical departments.

Handling Tank Cars Under Rules of Bureau of Explosives*

(After some brief remarks by E. J. League, Chicago, and Thos. O'Donnell, St. Louis, representatives of the Bureau of Explosives, the following discussion took place.—Editor.)

A. C. Campbell (N. Y. C. & St. L.): I would like to know what is being done at interchange points about removing placards from empty tank cars that were loaded with gasoline. In our district, we are having them come in with the placards not removed.

Chairman Armstrong: For the Atlantic gateway, I can say that on the failure of the consignee to remove the card, as prescribed by the Bureau of Explosives and also by the A. R. A. rules, the handling line or delivering line is penalized.

T. S. Cheadle (R. F. & P.): We have the same condition in my part of the country. I believe, from the condition, somebody thinks they have removed the placard when they have put some paint over it or have run a sharp stick through it. As I understand the last interpretation given by the Bureau of Explosives, it is compulsory that we remove the placard and not paint it over or cancel it. I would like to ask one of the chief inspectors to verify my opinion.

Thos. O'Donnell (St. Louis): If the placard is painted in such a manner as to remove the trace of its identity, painting will do. The regulations for the transportation of explosives will be satisfied if the painting is such that it cannot be recognized as an inflammable placard.

F. A. Eyman (E. J. & E.): I would like to ask why that rule for removing placards from empty tank cars, which have contained dangerous articles such as gasoline or acid, was issued. Doesn't the practical man understand that a lot of those cars that they say are empty are still very dangerous?

Chairman Armstrong: The regulations for the safe transportation of explosives and other dangerous articles are issued by the Interstate Commerce Commission, warning you that all tank cars, when empty, are dangerous, whether they were previously placarded or not. The general rule in the transportation of dangerous articles is to remove labels and

*Abstract of a discussion at the convention of the Chief Interchange Car Inspectors' and Car Foremens' Association, Chicago, October 3, 4 and 5, 1923.

placards from packages that are empty. Under the interpretation, a tank car is a package; therefore, it was the great outstanding exception to the rule. Placards were allowed on tank cars that had previously contained dangerous liquids, but after fifteen years of experimentation, the Bureau of Explosives found that tank cars, when empty, even though they did not formerly contain dangerous articles, were dangerous.

To have some empty tank cars placarded "inflammable" and not have other empty cars placarded and know they were dangerous, brought about a condition of confusion. Therefore, knowing that any empty tank car was liable to contain dangerous inflammable gases, it was decided that the safest way was to treat them all alike and remove the placards and put a warning in the Interstate Commerce Commission regulations, which is in there now, that empty tank cars, with or without placards, are liable to contain dangerous gases and should not be approached or entered with a light. This has made handling of all empty containers uniform, that is, all placards and labels have been removed.

Mr. O'Donnell: A few weeks ago, my attention was called by the claim department to losses occurring in the transfer of gasoline and some other light oils. After being transferred at a large interchange point, carloads were refused at destinations because of discoloration of the contents. A careful investigation showed that at a point where these cars were transferred from other cars, pumps were used and pipe lines and apparatus which were not cleaned. Consequently, after running 8,000 gals. of gasoline, as an instance, through one of these pumps, it showed a high discoloration, enough to have it refused at destination and, in the end, enough to cause over $300 claim against the terminal line.

When you connect a loaded tank with an empty one for transfer, you ought first of all to see that the empty tank car is clean, so clean as to be able to accommodate the load. You ought to know that pipes leading from the pumps or connections to the empty tank car are clean, that pump connections are clean, and that the pump itself is clean.

I found, on one occasion, that it was necessary to pump 50 gal. of gasoline through a pump before we got clean gasoline. It is far cheaper and safer and better for you to run a sufficient amount of gasoline or any light oil through the pump and salvage this oil in a barrel and use it at the shops, than to destroy or discolor the whole contents of the tank car by a hasty or ill-advised transfer.

Letter from Colonel Dunn (Bureau of Explosives)

Secretary Elliott: We have a communication here from Colonel Dunn which I will ask Mr. League to present as he is familiar with it.

Mr. League: Colonel Dunn would like, after I have read this letter, to have it discussed, and he is anxious to have the expression of the individual opinions of this Association, and perhaps, later, a resolution or something of that kind, as the sense of the body. The letter is as follows: "Recently, one of our inspectors approved the holding up and transfer of a number of tank cars with shells overdue for test, although the cars were in every other respect in proper condition for transportation. These cars were held up on the authority of Interchange Rule 3(e), although Paragraph 1007, qualified by Paragraph 3 of the I. C. C. Regulations (which take precedence over interchange or classification rules) clearly provides for the forwarding of tank cars of inflammable liquids under these conditions.

"It is evidently desirable that a change be made in this interchange rule to provide an exemption, based on Paragraph 1007. It may further be necessary to provide that empty tank cars, with shells overdue for test, may be accepted in interchange when destined to the owner or lessee to be retested."

Rule 1007 referred to there is this: "Unless they are leaking or in a manifestly insecure condition, packages of dangerous articles, other than explosives, when in transit, must be forwarded and report made. Leaking packages must not be forwarded."

Paragraph 3 of our regulations defines the word "package": "Where the word 'package' is used, it shall be understood to include all outside containers, including tank cars."

It seems strange that you should have in your interchange rules, authority to pass a car with a load, whose valves are due for a retest or having passed the date of test. Why should we permit that car to go forward under the card passed by the I. C. C. rules, and yet hold the car up because the test of the shell has expired? Why not amend that interchange rule to include the test of the shell as well as of the safety valve?

Quoting further from Colonel Dunn's letter: "It is my thought that you will have a splendid opportunity at the meeting to get an expression of opinion from many sections of the country as to what conditions justify the hazards involved in the transfer of the contents of tank cars at interchange points.

"Recently, one of our inspectors was called upon to superintend the transfer of several tank cars of gasoline, and, upon his arrival at the scene of transfer, he found that two of the cars showed no dropping of liquid from the rivets. The only indication that they were not tight was an oily stain. All arrangements having been made to transfer the lading, he did not think it advisable to order these cars forwarded to destination for fear of encouraging lax inspection of future shipments.

"Transferring the contents of a tank car of inflammable liquid is an operation attended by far greater possibilities of a serious accident than could result from forwarding to destination a tank car showing slight leakage at rivets and seams.

"The question naturally arises as to what is the proper definition of a leaky tank car. From the standpoint of comparative safety, it would seem reasonable to allow the forwarding of a tank car which was not leaking more than a total of 60 drops a minute from loose rivets and seams. In other words, if six rivets at different points on the shell were leaking at the rate of less than ten drops per minute each, the hazard of allowing the car to proceed to destination would be far less than that attendant upon transferring contents at some interchange point, or in close proximity to rails over which engines are operated, especially when the transfer has to be done by railroad employees without the supervision of an inspector of the Bureau of Explosives.

"Before making definite recommendations for changes in the I. C. C. regulations defining a leaky tank car, as referred to in Paragraphs 1007, 1042, 1043 and 1049 (c), I desire an expression of your opinion as to the desirability and practicability of definitely defining a leak. The Commission's rule that outlet valves must not permit more than a dropping of liquid with valve caps off has been a subject of much controversy in the past, and recently, at a joint meeting of the American Railway Association and American Petroleum Institute sub-committees on bottom outlets, a set of recommended rules was drafted and is now awaiting approval of the oil industry and the A. R. A. One of the rules reads:

" 'Cars must be loaded with bottom outlet caps off. If total dropping of the liquid being loaded is in excess of 60 drops per minute, cars must not be shipped until valves are repaired.' "

This rate of leakage does not indicate a condition of the valve which is liable to result in a serious uncontrollable leakage.

By furnishing a definition of a leaky bottom outlet valve, seam, or rivet, we eliminate the opportunity for differences in judgment of the individual and get down to a basis where

we can apply a penalty for failure to comply with a definite requirement.

Thos. O'Donnell (St. Louis): Colonel Dunn's letter does not ask for any more than an expression. We think that a leaking tank car, or a slightly leaking car, is a far safer proposition than the transferring of that car, and we consider it is safer to let the car go on to destination with a slight, clearly defined leak which we think cannot get worse, than to take that tank car and transfer it in a busy interchange point, perhaps under most unfavorable conditions.

Geo. Lynch (Cleveland, Ohio): I do not think that it would be wise to run a tank car leaking at the rivets, or as mentioned in Mr. Dunn's letter. The tank does not improve in service or handling and is liable to become more leaky than it is at the point of interchange.

Secretary Elliott: If I am in order, I will move that, at the proper time, we recommend to the Arbitration Committee that Rule 3 be so worded as to harmonize with the regulations of Paragraph 1007, to permit tank cars with tests out of date to run to destination and back again to the owner. I would also include in that motion that we ask the Bureau of Explosives to define what they consider a leaking tank car that is safe for further movement.

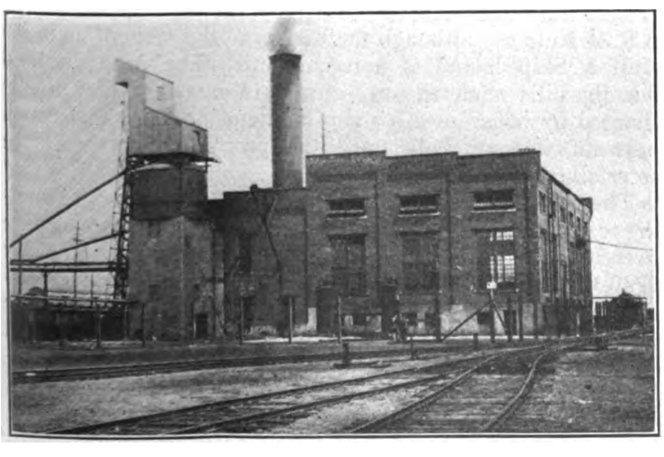
The motion was duly seconded.

T. J. O'Donnell (Buffalo): The Bureau of Explosives has put before us a logical and sensible thought. In the terminals we dislike very much to see cars transferred where there is hardly a perceptible liquid leak. In our Association we take chances on 50, 60 or 70 drops with common oil; kerosene we sometimes take chances with, but with gasoline, if there is any perceptible leak—a drop—we take no chance. That tank is held there and the superintendent or management has to determine what we will do. I would not take a chance of having a boilermaker come in and do much on a tank leaking gasoline. I am afraid of it.

F. W. Trapnell: I should judge that, for the last 15 years or longer in our territory, a car leaking gasoline at 60 to 75 drops a minute, no mention is made of it and the car is allowed to proceed. We have never had any trouble. Relative to the shell of the tank, I can see no good reason why we should transfer a car when the shell of the tank is overdue for test, any more than we should tie up the car for the safety valve test.

Chairman Armstrong: The motion is that this body go on record as requesting the Arbitration Committee to change the rules to allow a shell overdue for test to go forward to destination, and that the Bureau of Explosives, in connection with the A. R. A., define the extent to which a tank must be leaking before it is transferred.

The motion was carried.



Power House at the Billerica, Mass., Shops of the Boston and Maine

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Failure to Furnish Sufficiently Specific Information

On September 4, 1922, the Gulf, Colorado & Santa Fe furnished an inspection certificate to the Chicago, Milwaukee & St. Paul, requesting disposition of C. M. & St. P. box car 73500, located at Cleburne, Tex. In compliance with footnote to Rule 43, the handling line also advised the owner that the car had not been subjected to any of the unfair conditions enumerated in Rule 32, and that, therefore, the car was a subject for handling under Rule 120. The Chicago, Milwaukee & St. Paul declined to furnish disposition under Rule 120 on the ground that insufficient information had been furnished by the Gulf, Colorado & Santa Fe, in its efforts to comply with the footnote to Rule 43. In order to prove that its inspection certificate was correct the handling line asked that the car owner send a representative to inspect the car; however, the car owner refused as it did not consider such a procedure necessary. The Gulf, Colorado & Santa Fe claimed that the condition of the car itself was the best evidence available in support of its position, and the attention of the Arbitration Committee was brought to the owner's failure to inspect the car.

It was decided by the Arbitration Committee that the handling line, having failed to furnish the car owner specific information as required by the note under Rule 43, should assume the responsibility.—*Case No. 1283, Chicago, Milwaukee & St. Paul vs. Gulf, Colorado & Santa Fe.*

Making Wrong Repairs to Damaged Cars

The International-Great Northern rendered a bill for repairs during July, 1921, against the Ft. Worth & Denver City, a part of which included the application of yoke bolts to F. W. & D. C. car No. 5522. It also billed this company for repairing the running boards on cars No. 4117 and No. 4146. The Ft. Worth & Denver City objected to the charge against its car No. 5522, contending that the repairs made were not standard to this car. It also objected to the charge against its cars No. 4117 and No. 4146, claiming that the bill did not show that screws were actually used in this work and that the A. R. A. Rules did not make allowance for labor charges unless screws were used.

The Arbitration Committee decided that, "In view of yoke rivets being the standard of the car, the charge for the yoke bolts should be withdrawn. If original record of repairs shows screws as having been used, billing repair card may be amended to charge for same."—*Case No. 1284, Ft. Worth & Denver City vs. International-Great Northern.*

Rule 32—Car Damaged in Switching

On April 9, 1921, the Gulf, Colorado & Santa Fe submitted to the Gulf Coast Lines a joint inspection report showing a number of defects to be existent on G. S. N. O. & P. car No. 122097 at Cleburne, Tex. It also advised the Gulf Coast Lines that the defects developed while the car was being switched and that there was no unfair usage according

to Rule 32. Disposition was therefore requested in accordance with A. R. A. Rule 120. However, the Gulf Coast Lines made an inspection of this car at Cleburne and reached the conclusion that the car had been unfairly used at some previous time.

Upon making further investigation, it discovered that the car had been sideswiped at Kansas City, Mo., while on the lines of the Santa Fe and as a result, it had undergone repairs at the Argentine, Kans., shops on February 12, 1921. The Gulf, Colorado & Santa Fe claimed that the damage was due to the sills giving way and finally breaking while the car was being handled by a switch engine in a cut of cars which was being pushed up to couple on to the rest of the train. It also contended that the damage done to the car on account of being sideswiped at Kansas City was completely and properly repaired at the Argentine shops and that the reason for failure at this time was on account of the car being in a weak and worn-out condition.

The decision of the Arbitration Committee was as follows: "The original record of repairs made to this car by the Gulf, Colorado & Santa Fe, February 18, 1921, contains a notation to the effect that the metal center sills and metal side sills were broken, while the record of repairs actually made shows these metal members as having been straightened only, it being evident that proper and complete repairs were not made. It may be reasonably assumed that the impaired condition of the car, due to the unfair damage for which the handling line was responsible, contributed to the subsequent damage to the car. Therefore, the Gulf, Colorado & Santa Fe is responsible for the damage.—*Case No.* 1286, *Gulf Coast Lines vs. Gulf, Colorado & Santa Fe.*

Loss of Lading Due to Leaking Safety Valves

Tank car TIDX 114 was loaded with gasoline at the Keystone, Okla., plant of the Tidal Refining Company on June 1, 1922. Upon arrival at its destination it was discovered that the tank car was short 708 gallons on account of the safety valves leaking. The stenciling on the car showed that the safety valves had been tested at 25 lb. pressure by the St. Louis-San Francisco at West Tulsa, Okla., on May 7, 1922, and a charge covering this work was rendered against the Tidal Refining Company in the customary manner.

It was contended by the Tidal Refining Company that this charge should be eliminated and the responsibility of the loss of the lading acknowledged by the St. Louis-San Francisco. However, the handling line claimed that the owner had loaded the car at its own plant and had taken no exception to the condition of the valves when the car was loaded. It further contended that any defects which might have developed did so after the car had moved from the owner's plant and should be classed as the owner's defects, instead of wrong repairs.

The decision of the Arbitration Committee was as follows: "The St. Louis-San Francisco gives positive assurance that the safety valves on this car were properly tested and adjusted to open at a pressure of 25 lb. per sq. in. There is no conclusive evidence to the contrary at the time the work was performed. The contention of the Tidal Refining Company is not sustained."—*Case No.* 1287, *St. Louis-San Francisco vs. Tidal Refining Company.*

Owner Is Made Responsible for Car Damaged by Rough Handling

On September 5, 1922, C. S. N. O. & P. car 122166 was badly damaged in switching on the St. Louis-San Francisco at Neodesha, Kans. The handling line wrote to the car owner on October 17 requesting disposition under A.R.A. Rule No. 120. As the total cost of reconditioning the car amounted to $1,500, the Gulf Coast Lines sent an inspector to Neodesha to investigate this case. The inspector reported that the center sills were bent and broken at the body bolster and that there were flange marks on the center sills and end sill, which indicated that the car had no doubt been derailed and that it received unfair usage.

At the time of the inspection, a St. Louis-San Francisco standard bad-order card, Form M.P. 19, on which there was a notation stating that the car had been "torn to pieces by Frisco crew," was removed by the Gulf Coast inspector. A routing card was also removed which indicated that the car was in condition to carry a load of lumber on August 3, 1922, shortly prior to the damage. This evidence, with a statement calling the attention of the Arbitration Committee to the fact that the car had been handled during a strike period in the Neodesha yards and that the yard switching forces were very sympathetic to the strikers, was also submitted. As a result of the evidence collected, the Gulf Coast Lines claimed that the car was damaged by impact other than ordinary yard and terminal switching.

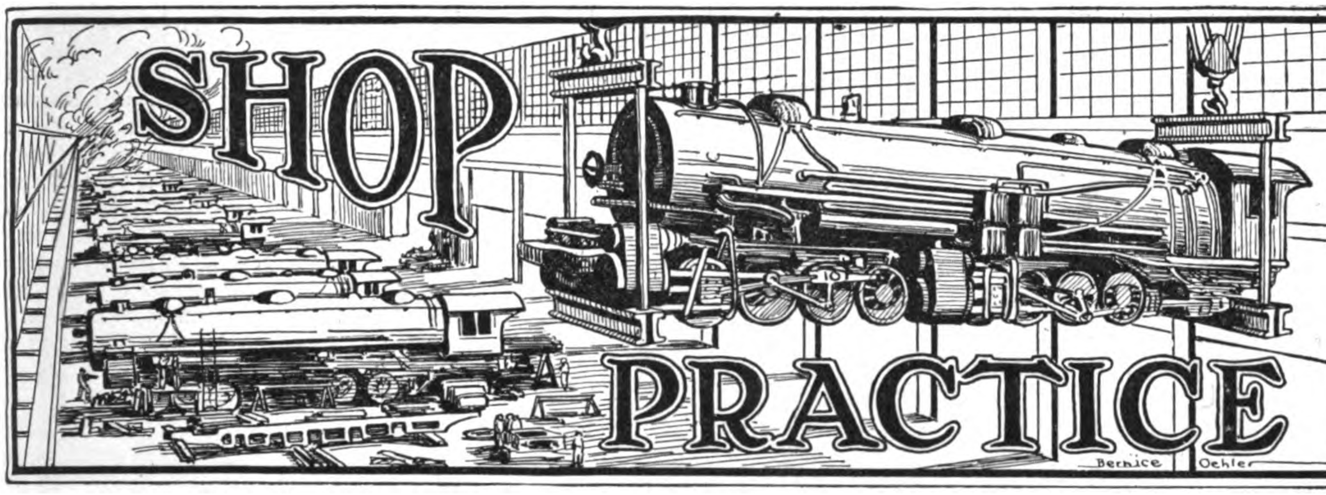
The Frisco submitted a number of affidavits made by various members of the yard crew and car department officers of the Northern division stating that the car had not been derailed, cornered or sideswiped and neither had it been in any collision or impact other than that occurring in regular switching service. It also brought out the fact that the evidence submitted by the Gulf Coast Lines relative to the car being derailed had been confused with another car, 43050, that was the property of the St. Louis-San Francisco, which had been derailed and was in no way connected with C. S. N. O. & P. car 122166. The Frisco claimed that the routing card of August 3, 1922, was no indication that the car had been unfairly handled and asked disposition according to Rules 43 and 120, contending that this case was not a proper subject for Rule 32.

The Arbitration Committee decided that there was no evidence that the car was subjected to any of the unfair conditions named in Rule 32, and that therefore the owner was responsible under Rules 43 and 120.—*Case No.* 1288, *St. Louis-San Francisco vs. Gulf Coast Lines.*

Journal Boxes Not Properly Repacked

A number of bills were rendered to the Illinois Central by the Gulf & Ship Island covering repairs to its equipment for the months of July, 1921, to January, 1922, inclusive. The Illinois Central took exceptions to certain items relating to the repacking of journal boxes on five of its cars and refused payment on all of the bills. The objection was based on a joint inspection report made by inspectors of the Illinois Central and the Alabama & Vicksburg, which stated that the journal boxes had not been repacked in accordance with A.R.A. Rule 66, although the cars bore the stencilling of the Gulf & Ship Island of a recent date. The owner claimed that the bills rendered were greatly in excess of that usually charged by other lines for similar items and for that reason payment was withheld until the proper charges could be ascertained.

The Arbitration Committee decided as follows: "According to the joint evidence statements, the journal boxes on these five cars were not properly repacked, as per Rule 66 of the 1920 Code. In fact, however, the joint inspection is not conclusive evidence that the work was not performed, with due consideration to the intervals between the dates the journal boxes are claimed to have been properly repacked by the Gulf & Ship Island and the dates of the joint inspection. Therefore, the contention of the Illinois Central is not sustained.—*Case No.* 1289, *Gulf & Ship Island vs. Illinois Central.*



Welding on Copper Fireboxes of Locomotives

Successful Results Obtained in Europe with the Oxy-Acetylene Torch and Special Filler Rods

By J. F. Springer

THE Germans have been accumulating valuable experience relative to repairs on locomotive fireboxes constructed of copper. The results achieved are of value to Americans largely because copper welding is in itself an art that is not understood by the majority of oxy-acetylene welders as well, perhaps, as it ought to be. Repairs are usually required on account of corrosion of the metal through the action of the heat in the firebox. The expansion and contraction due to fluctuations in temperature cause cracks to appear in the side and crown sheets and it is also necessary to repair the fireboxes on account of the frequent renewals of flues and staybolts and the consequent enlargement of the holes.

Under ordinary conditions copper is softer and more pliable than cast iron or steel. On the other hand, its coefficient of expansion and contraction is much greater. Its temperature of fusion is only 1,980 deg. F. and the metal is liable to undergo destructive oxidation just below this temperature.

It seems that in Germany the repairs were formerly carried out by mechanical methods. If both the front and back of the sheet was accessible the patch would be riveted on, but if the workman could get at only the front side, screws would be substituted for the rivets. As a result of the ineffective way in which the joints were made leaks were quite prevalent.

Patches on copper fireboxes are required in all sorts of locations and sometimes it is necessary to stop up some of the tube holes in order to provide a space sufficiently broad for the patch and the rivets or screws. Rivets are preferable to screws because they will keep a seam tight for a longer period. There are, however, some shops in Germany where not only patches, but even tube sheets and back sheets are secured by means of patch screws. It is also reported that the workmen did not seem to know that either bent or shortened rivets could be applied instead of the ordinary straight rivets.

The Result of Overheating and How It Can Be Prevented

Attention has been directed to the evil effects of heating copper to a point near 1,980 deg. in the presence of oxygen. The oxidized copper produced by the absorption of oxygen has a lower melting point than pure copper and will dissolve in the purer metal and corrupt it. Copper which has suffered in this way is known as burnt copper and can usually be detected by its purplish color. Its physical qualities are more or less reduced, which affects the usefulness of the metal. Pure copper, seen in a fresh break, is of a rose-red or yellow-red appearance.

The operator has the choice of two procedures in order to prevent overheating. One is the application of materials which will absorb the oxygen, and the other consists in getting rid of the oxygen which has already been absorbed. Where the metal has already absorbed oxygen, he may employ the enveloping flame produced by the torch, which is known as a reducing flame.

It is recommended that materials designed to hinder the absorption of oxygen by the copper be incorporated in the welding rod, as this will facilitate the making of equal additions throughout the welding process. There is a patented alloy composed of copper, phosphorus and silver that has been used successfully. The phosphorus is the active agent used to prevent the oxidation of the copper. It absorbs oxygen quite readily and the result is a chemical combination of the two elements, in which the phosphorus combines with the oxygen in the oxidized copper and forms phosphoric acid which escapes by evaporation.

There is also an alloy that has been patented by a Frenchman, M. Raoul Amedeo, that utilizes the affinity of vanadium for oxygen. The vanadium content is about 0.4 per cent. It is claimed that by the use of this material the big-grained structure, which is to be expected as a result of overheating of the welding region, is prevented. Furthermore, this welding rod seems to have an additional merit since it is claimed to reduce the surface tension of the molten metal, thus permitting the metal to spread promptly to all parts of the welding location.

A paste has also been developed, which is smeared over the welding location and the near by parts in advance of any welding operation. Its good results are obtained largely through the protection afforded by a film which forms over

the surface and thus prevents oxygen from getting into contact with the highly heated metal.

Importance of Proper Torch Handling

An important precaution to be considered is the manner of handling the torch. The little white flame near the tip of the burner is not permitted to come into contact with the copper. The actual fact back of this appears to be that when the mixture of C_2H_2 and O emerges from the orifice, almost immediately the acetylene breaks up into C and H and the three elements, C, H and O, flow along for a space without combining with one another. This space is approximately where the whiteness appears. Consequently, by avoiding contact of the white flame with the metal, we avoid pouring free O onto the heated metal. How far the outer end of the white flame should be kept from the copper is best ascertained by experiment.

In adjusting the flame, the operator must be careful not to provide an excess of oxygen. It will be well to be on the safe side and adjust the apparatus so that there is a deficiency of oxygen; that is, an excess of acetylene. This may be accomplished after the neutral condition has become existent by opening up with the acetylene valve or shutting off of the oxygen valve. The proper regulation may readily be found by trial. The torch should be managed so as to cover with its outer flame the portion of the seam that has just been welded.

In welding copper fireboxes, we are apt to have vertical welds. These might prove to be troublesome unless proper precautions are taken. It has already been suggested that we have the C, H and O in uncombined condition near the tip. Highly heated copper, especially molten copper, may be expected to absorb readily any available hydrogen. As the cooling continues, bubbles of hydrogen will rise towards the surface, but some will never reach it unless conditions are favorable. Thus, in vertical welds we may expect a tendency to porosity from this cause.

Wrongly Designed Torches

Experience indicates that not all oxy-acetylene torches are suitably designed for copper welding. What is wanted is a torch such that when the oxygen and acetylene supplies are once satisfactorily adjusted the adjustments will remain fixed. It may be said that in many cases heat causes a change in the proportions of the mixture of the two gases passing through the torch. This condition is undesirable. The welder of steel and iron is not greatly affected because he usually wants the normal flame and it is very easy to tell at any time whether he still has it. The copper welder wants a certain adjustment of proportions, but does not seem to have a quick, easy and sure method of correcting any departure, or even of noting whether any departures have occurred. Consequently, the burners are constructed with the mixing compartment far removed from the tip so that the supply of the two gases is influenced as little as possible by the heating of the tip. On the other hand, the heat influence still present results in an equalized action upon the acetylene and oxygen through a suitable introduction of the gases, which leads to better operating conditions.

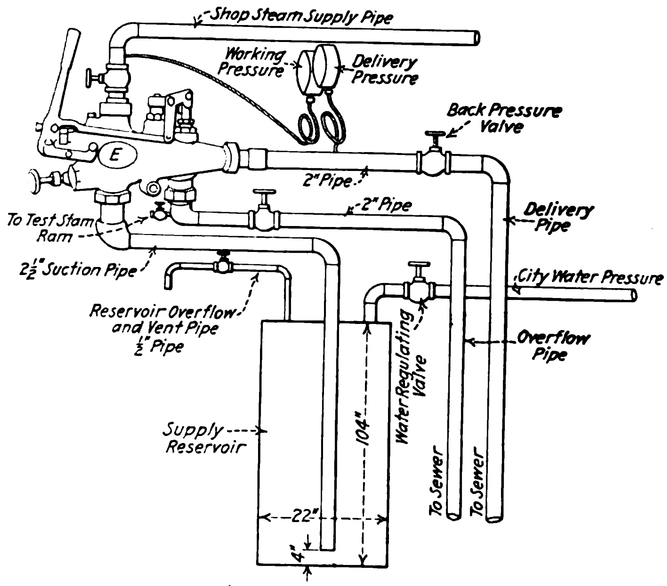
An Actual Example

In order to make sure that the reader understands the practical application of this process, let us take the case where a crack has developed between staybolt holes. The preheating and welding is done from the fire side. As this side warms up faster than the other, a bulge occurs which serves to open up the crack. Sufficient fresh metal is then added to fill the crack and at the same time allow for the bulge. Upon cooling, the sheet contracts and goes back to its previous flat condition with little or no stresses developing in the metal.

Injector Test Rack

The testing of an injector after it has been overhauled is an important operation. Very often a locomotive which has recently been shopped has to be taken out of service because its injectors have failed to work and quite often these failures are caused by the way the injectors are tested. In some shops they are tested by air or water, which does not provide a natural operating condition for such tests.

By referring to the sketch, the reader will note that the injector is set up in exactly the same manner as it is required to function on the engine. Two gages are provided, one to regulate the pressure in the delivery pipe and the other to



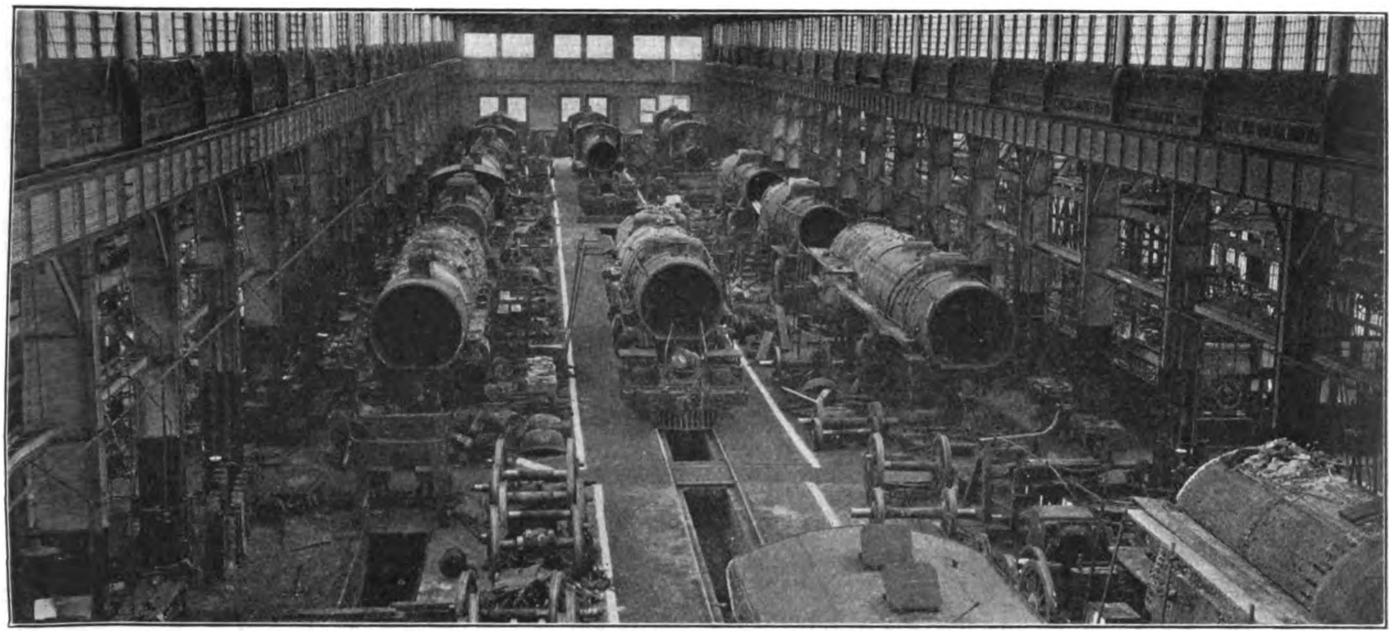
This Apparatus is Designed to Give An Injector a Complete Operating Test

indicate the pressure in the steam supply pipe. Water is piped to a tank, which may be made from an old air reservoir, in order to give the injector the same source of supply as it would have if pumping water from the tank of a locomotive. The lifting capacity with certain steam pressures, as well as the amount of water discharged, can easily be ascertained by placing a barrel or tank of known capacity with the outlet pipe and operating for a definite length of time.

It is found to be proper practice in testing an injector to create a pressure in the delivery pipe 40 per cent in excess of the usual working pressure. This tends to insure perfect operation when applied to a locomotive.

The delivery pressure is controlled by the back pressure valve which may be turned as desired so as to show exactly what the injector is able to accomplish.

Assortment of Non-Interchangeable Grate Shaker Bars Found at One Small Terminal



Interior View of the Erecting Shop, Buffalo, Rochester & Pittsburgh, Dubois, Pa.

B. R. & P. Has Well Organized Production Shop

Excellent Results Are Being Obtained by Efficient Management and Organization of Personnel

THE methods by which efficient and economical production has been obtained in the Maintenance of Equipment Department, particularly that of repairing locomotives at the general repair shops of the Buffalo, Rochester & Pittsburgh, located at Du Bois, Pa., should be interest to railroad shop men. These shops are of the longitudinal type, with machine bays at each side and three pit tracks in the center of the erecting shop served by two 50-ton electric cranes. As the height of the machine bays prohibits the use of overhead traveling cranes, all necessary lifting service in the machine bays is taken care of by jib cranes and overhead electric and pneumatic trolley hoists.

Limited Program of Repairs Facilitates Efficient Operation

The normal program of repairs allows but 20 engines on the erecting pits at one time, eight on each side pit and four on the center. This allotment has demonstrated its wisdom as plenty of room is thus provided for working access to the locomotives. In addition to insuring that all material is properly placed, the congestion that naturally follows when a large number of locomotives are in the shop at one time is eliminated.

No locomotive is taken into the shop except for general repairs. All non-classified and other repairs not necessitating heavy overhead crane assistance are taken care of in the enginehouses of the respective divisions. Engines which are to go through this shop are not placed on the schedule until after the boiler inspection has been made.

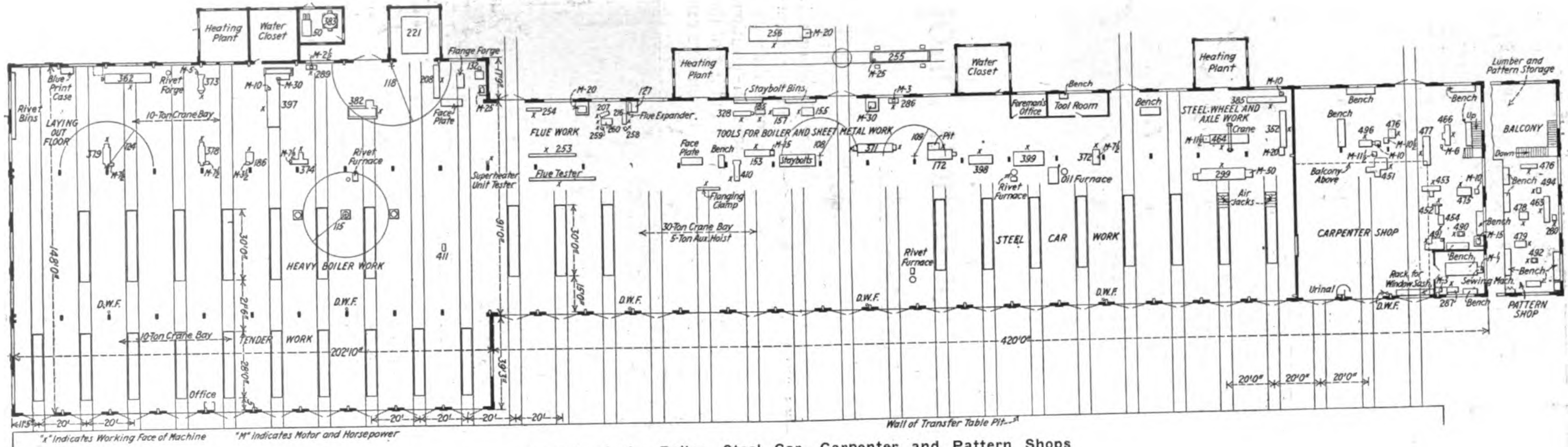
Routing of Locomotives and Parts

All locomotives are stripped on the center pit and set over to their assigned places on the side pits. The parts are delivered to the lye vats, after which they are routed to the various jobs to which they have been assigned.

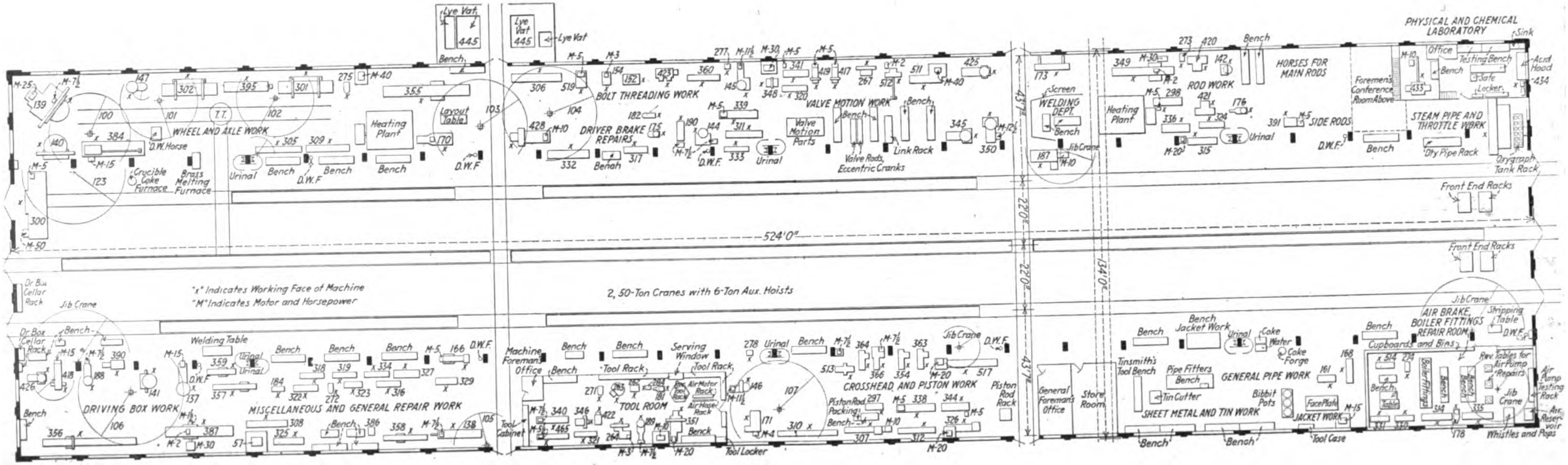
The wheeling of all engines, regardless of the type, is done on the center pit. Wheels, complete with the boxes and with binders and wedges supported on pedestals, are placed on this pit. The shoes are then placed in position in the frame jaws and when the engine is lowered onto the boxes, the shoes, wedges and binders are automatically placed in position. This method eliminates extra movements and handling of the heavy binders. The wheeling of an ordinary locomotive can be finished in approximately one-half hour, with all the shoes and wedges in position and binders up complete by one supervisor and four men.

Special Attention Has Been Given to the Grouping of Machine Tools

The wheeling position of each locomotive on the center pit is predetermined with a two-fold object: first, to prevent any obstacle getting in the way of direct and unobstructed



Layout of the Boiler, Steel Car, Carpenter and Pattern Shops



Floor Plan of the Machine and Erecting Shop

BOILER AND STEEL CAR SHOPS

50 Duplex, 14 in. by 2¼ in. by 12 in., pump water.
62 and 78 30-hp. motors.
63 20-hp. motor.
64 15-hp. motor.
65 11½-hp. motor.
66 10½-hp. motor.
67 and 68 6-hp. motors.
69 3½-hp. motor.
374 Rotary beveling, shear, capacity ⅝-in. steel.
378 Shear, 54-in. throat.
379 Punch, 54-in. throat.
382 Hydraulic vertical flanging press.
383 Hydraulic accumulator.
385 Hydraulic driving wheel press, 84 in., 300 tons.
397 12-Ft. plate bending rolls.
398 6-Ft. open end plate bending rolls.
145 and 146 36-In. vertical boring mills.
147 48-In. vertical car wheel boring mill.
152 2-In. double head bolt cutter.
154 1½-In. double head bolt cutter.
161 3-In. pipe threading machine.
166 4-In. single head horizontal nut tapper.
168 8-In. pipe threading machine.
170, 171 and 187 6-ft. radial drill presses.
335 17-in. by 7-ft. engine lathe.
336 3-in. by 36-in. flat turret lathe.
338 and 339 18-in. by 9-ft. geared head engine lathes.
340 18-in. by 6-ft. geared head engine lathe.
341 and 344 Universal hollow hexagon turret lathes.
345 and 350 42-in. vertical milling machines.

73 1½-hp. motor.
74 25-hp. motor.
77 5-hp. motor.
79 10-hp. motor.
83 3-hp. motor.
108 Jib, crane, 16 ft. radius, ½-ton capacity.
109 Jib, crane, 13 ft. radius, ½-ton capacity.
115 Portable post, crane, 18 ft. radius, 3,000 lb. capacity.
118 Post jib, crane, 26 ft. radius, 1-ton capacity.
124 Post jib, crane, 20 ft. 6 in. radius, 1½ tons capacity.
127 and 132 Pressure blowers.
153 Vertical 6-spindle staybolt cutter.
155 2-In. double head bolt cutter.
157 1½-In. double head bolt cutter.
172 6-Ft. radial drill press.
185 Centering machine.
186 40-In. upright drill press.
207 and 216 Flue heating furnace—oil burning.
208 11-Ft. pneumatic flanging clamp.
221 Plate heating furnace—oil burning—8ft. 10 in. by 14 ft. 0 in.
253 and 254 Flue cutting machines.
255 Flue cleaner, overhead type.
256 Flue cleaner, dry.
258 Pneumatic flue welding machine for super-heater tubes.
259 Pneumatic flue swagging machine.
260 Flue welding machine.
280 Tool grinder—equipped with oilstone, leather and emery wheel.
286 and 289 Double tool grinder.
287 Hair picking machine.
299 28-In. by 42-in. car wheel lathe.
328 2-In. by 24-in. flat turret lathe.
352 Single head, extra heavy axle lathe.
362 20-Ft. plate planer.
371 Punch and shear, 48-in. throat.
372 Punch and shear, 20-in. throat.
373 Horizontal Punch, 8-in. throat.
399 61Ft. plate straightening rolls.
410 9-Ft. steam riveter.
411 24-In. portable pneumatic riveter.

CARPENTER AND PATTERN SHOPS

451 Mortiser and boring machine.
452 Chain saw mortiser, ¼ in. to 1 in.
453 Single-spindle post boring machine.
454 Single spindle boring machine.
463 24-In. wood lathe.
464 40-In. engine lathe.
466 24-In. hand planer and jointer.
467 16-In. hand planer and jointer.
475 42-In. band saw.
476 and 478 Universal bench saw.
477 Swing cut-off saw.
479 32-In. band saw.
490 and 492 Portable hand trimmer.
491 Shaping and friezing machine.
494 Rod machine.
496 Tenoning machine with cope head.

MACHINE AND ERECTING SHOPS

56 and 57 40-hp. motors.
58 20-hp. motor.
59 30-hp. motor.
60 15-hp. motor.
61 10-hp. motor.
100 Jib, crane, 15-ft. 6-in. radius, 8 tons capacity.
101 and 102 Jib cranes, 13-ft. 6-in. radius, 5 tons capacity.
103 and 104 Jib crane, 16-ft. 4-in. radius, 3 tons capacity.
105 Jib crane, 11-ft. 3-in. radius, 1 ton capacity.
106 Jib crane, 18-ft. radius, ½ ton capacity.
107 Jib crane, 17-ft. radius, ½ ton capacity.
123 Electric post jib crane, 19-ft. radius, 8 tons capacity.
137 Boring and facing mill for driving boxes, 54 in.
138 Boring and drilling machine, 66-in. horizontal.
139 Boring and turning mill, 100-in. extra heavy.
140 84-In. vertical boring mill.
141 51-In. vertical boring mill.
142 37-In. vertical boring mill.
144 42-In. vertical boring mill.
173 Two spindle drill press.
175 28-In. upright drill press.
176 32-In. upright drill press.
178 24-In. upright drill press.
181 21-In. upright drill press.
182 20-In. upright drill press.
184 Centering machine.
188 and 190 42-in. upright drill presses.
189 36-In. upright drill press.
262 Drill grinder.
263 Tool grinder.
264 and 267 Universal grinders—Internal and external cylindrical grinding.
271, 272, 273, 274 and 275 Single-wheel tool grinders.
277 and 278 Two-wheel tool grinders.
284 Single-wheel chaser grinder.
297 17-In. engine lathe.
298 3-In. by 36-in. flat turret lathe.
300 Locomotive wheel lathe—Extra high power, 100-in.
301 79-In. locomotive lathe.
302 79-In. locomotive wheel lathe.
305 12-In. by 9-ft. double axle lathe.
306 42-In. by 8-ft. 6-in. engine lathe.
307 24-In. by 5-ft. 6 in. engine lathe.
308 and 309 28-In. by 8-ft. engine lathes.
310 24-In. by 15-ft. engine lathe.
311 and 312 22-In. by 7-ft. engine lathe.
314 and 315 18-In. by 6-ft. engine lathes.
316, 317, 318, 319 and 320 16-In. by 4-ft. 6 in. engine lathes.
321 16-In. by 3-ft. 6 in. engine lathe.
322 and 324 16-in. by 5-ft. engine lathes.
323 16-in. by 3-ft. engine lathe.
325 21-in. by 7-ft. engine lathe.
326 and 327 3-in. by 36-in. flat turret lathes.
329 2-in. by 24-in. flat turret lathe.
330 and 331 18-in. brass turret lathes, Fox.
332 26-in. by 9-ft. engine lathe.
333 and 334 18-in. by 4-ft. engine lathes.
346 8-in. by 18-in. by 24-in. Universal milling machine.
348 Universal milling machine.
349 3-in. by 24-in. by 14-ft. horizontal milling machine.
351 Universal milling machine, with extra heavy vertical attachment.
354 20-in. by 24-in. by 24-in. crank planer.
355 60-in. by 60-in. by 18-ft. planer.
356 36-in. by 36-in. by 20-ft. planer.
357 and 358 26-in. by 26-in. by 10-ft. planers.
359 26-in. by 26-in. by 6-ft. planer.
360 26-in. by 26-in. by 7-ft. planer.
363 and 364 20-in. by 24-in. by 24-in. crank planers.
366 24-in. by 24-in. by 24-in. crank planer.
384 96-in. hydraulic driving wheel press, 600 tons.
386 30-ton portable axle bearing press.
387 48-in. by 48-in. by 14-ft. planer, reversing motor.
390 and 391 50-ton power vertical presses.
395 Wheel quartering machine, 45-in. by 72-in., swings 84 in.
417 and 419 24-in. high duty shapers.
418 36-in. draw cut shaper.
420, 421 and 423 16-in. transverse head shapers.
422 15-in. pillar shaper.
425 18-in. slotter.
426 14-in. slotter.
428 24-in. slotter.
433 Vertical screw testing machine, 300,000 lb. capacity.
434 Hydraulic testing machine.
445 Lye cleaning vats.
465 18-in. engine geared-head lathe.
511 Grinder, 30-in. guide with 7-ft table.
512 Radius grinder.
513 Keyseating and cottering milling machine.
514 18-in. turret lathe, Fox.
517 37¼-in. by 20-ft. geared-head engine lathe.
519 2-in. double head bolt cutter.

movement of the locomotive out of the erecting shop, and, second, to set a definite place for the delivery of all material that is to be applied. In the majority of cases the delivery of all material is expedited in advance of the time the engine is lifted from the side to the center pit. This prevents any delay by having to wait for material, in starting to assemble the engine after wheeling.

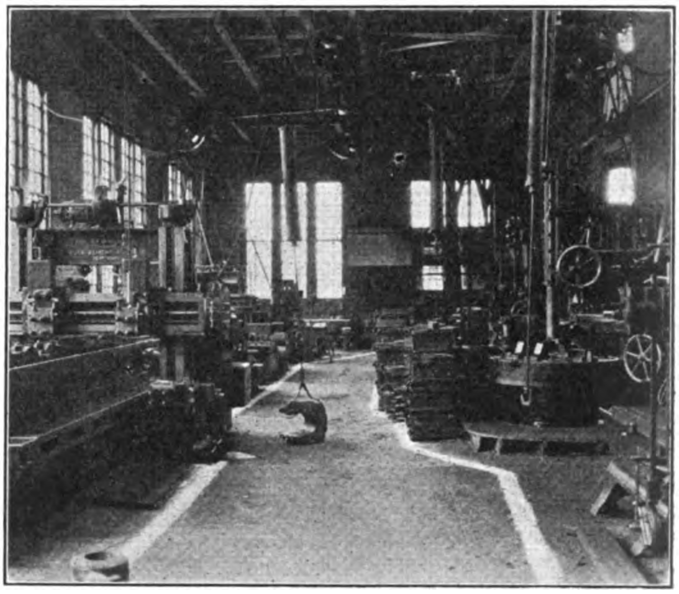
Care has been taken in the placing of the machine tools in the side bays to eliminate back tracking, or at least to keep it to a minimum. The whole plant is laid out so that the finished work travels toward the engine on the pit.

Each Foreman Is Responsible for His Department

Special attention to the grouping of the machine tools has made the various jobs self-contained and eliminates the dependence of one foreman on another. It also individualizes the work as well as the supervision, making each foreman completely responsible for the production of the work under his jurisdiction. The value of this arrangement in production is self evident and goes a long way to make the erecting department one of stripping and assembling only, as all work comes to the locomotive finished and ready to apply.

Department Organization and Machine Tool Operation

Each sub-division or department in the machine shop is fully equipped with all the necessary machine tools and equipment to complete its particular job. The department is so arranged that a part undergoing repairs travels from one



Where the Driving Box Work Is Done

machine to another in direct rotation and always toward the delivery point of the locomotive.

From time to time machine tools are replaced with those more efficient in production in order to obtain reduced costs per unit. A number of such tools have been installed within the last three years that have fully justified their purchase. For example, a 48-in., four-headed planer was purchased, on which, by the use of a special holding arrangement, a full set of driving boxes may be planed on the shoe and wedge faces at the one time instead of having to reset, as was the former practice. A driving box boring mill was also obtained that had a universal chuck built onto the table. This machine is equipped with a facing bar for boring and facing and, as a result, a driving box can be completed in 14 min. from floor to floor. A universal guide grinder is used to true the faces of exhaust bases in one set-up, to true up faces of slide valves and other similar parts, as well as to grind guides. It does away with the many operations that were formerly re-

quired on a planer, slotter, and various machines of the older types; and in the case of guide work, the blacksmith shop work was also eliminated with the consequent trucking from one place to another.

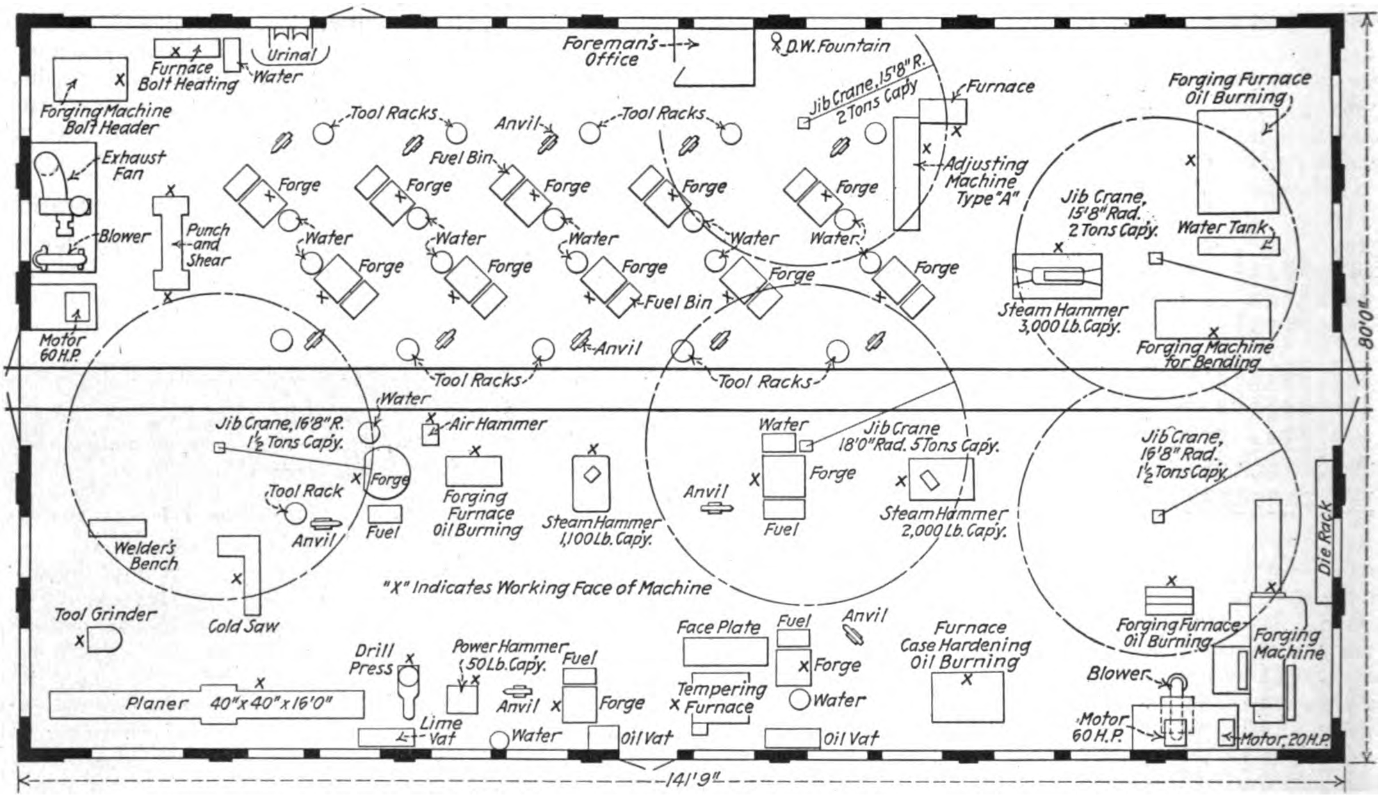
Two forcing presses also constitute part of the equipment, one being used for rod and the other for driving box work. The action and capacity of these machines give accurate and quick production and the pressures are controlled instantaneously. One 100-in. vertical boring mill, which is controlled from either side with a push bottom arrangement, has reduced labor costs 50 per cent. A 28-in. slotter of the radius type makes short work of link radii and is far ahead of the planer and attachment because of its ability to take cuts, feeds and speeds to the limit of the tool steel capacity. Many machines are equipped with special devices for various operations, with the object of completing the job to be done on one machine and thus reducing the handling costs.

All rod work is performed to standard tram lengths from master tram gages. A duplicate tram is used at all the enginehouses and terminals at other points on the line, which makes permanent the length for the rod when it is out of the general repair shop.

When driving boxes have been planed on the shoe and wedge faces to the limit of size, these faces are fitted with boiler plate liners, welded on, and the box is then brought back to its original size. This procedure renders it practically indestructible and makes available the use of each set of shoes and wedges for three shoppings of the locomotive.

Sub-Storeroom Provides Quick Service

In one of the machine bays a sub-storeroom is provided where stocks of small material are kept, such as standard stubs and bolts of all kinds, cotter keys, spring hanger pins, piston and valve rod packing, emery cloth, machine oil, waste and similar material. This greatly facilitates the repair work and does away with trips to the general storehouse. The shops are served with large or heavy material by an electric truck and all such material is delivered direct to the point where it is to be used.



Arrangement of the Equipment in the Blacksmith Shop

Utilizing Scrap Material

An oxygraph is installed in the south end of the erecting shop. This machine is used entirely for cutting out of the solid, main rod straps, pedestal binders, main and side rods, main rod wedges and engine truck equalizers wherever expensive operations in blacksmith and machine shop work can be eliminated. These parts are made out of scrap axles and the use of new material is thus avoided.

As an example, the production of a butt end main rod strap for a Mikado type locomotive normally requires 12 hours labor to forge and machine. With the oxygraph, the same job can be finished complete for application in three hours. A main connection side rod for the same type of engine can be produced by this machine in three hours and necessary machining accomplished in ten hours, as compared with the former process of forging and finishing in thirty-two hours of actual working time.

These two examples are but typical of the work that may be accomplished by this equipment. As the torch on this device uses acetylene gas, it is necessary to anneal the part after cutting to offset any possible strains that might be set up in the operation, but from experience none of the parts thus manufactured has failed in service.

The Toolroom Is Well Equipped

The toolroom is well equipped for the handling of small tools, tool and machine repairs, as well as for manufacturing jigs and devices designed for economy and to hasten production. Hand tools are issued by a check system and are inspected weekly for errors and replacements. The toolroom force has recently developed and put into operation a device for keyseating and reaming the bolt hole in main crank pins for crank arms after setting the valves of outside gear locomotives. With this device a more accurate and finished job can be accomplished and in one-half the time that was formerly required by using a drill and chipping hammer. The machine is pneumatically driven and is powerful enough to make available the use of high speed tool steel for milling and keyseating cutters.

Foremen's Meetings Are Held Twice Each Week

Scheduled meetings of all foremen are held with the general foreman each Tuesday and Friday morning, and at these meetings various items are listed on standard unit sheets and dates for the completion of each is set. From this information the date of each engine departure out of the shop is determined. If for any reason it is found that the date originally set cannot be met, immediate notice is given to the general foreman by the foreman involved, requesting necessary changes or that other action be taken to keep the locomotive on its original schedule as nearly as possible. This system has been found to be remarkably effective on account of its simplicity. The open conferences tend to promote an intensive spirit of co-operation which makes each foreman want to do his best to maintain the scheduled date of completion of the work.

The location of the boiler, tank work and heavy repairs to steel cars, as shown on the drawings, are self-explanatory. Here, as well as in the other repairs, the reader will find the element of efficiency that should be standard to such equipment and the same general arrangement common to all the other departments.

Incidental to the foregoing, it should also be stated that 90 per cent of the manufactured material used by the entire system is made at the Du Bois shop. All rods, pistons and crossheads, mounted engine trucks, tender and driving wheels, complete, are included in the material that is furnished to other terminals.

Acetylene and Electric Welding

The acetylene and electric welding processes are both used. The former is utilized for building up worn parts and the latter for making repairs to boiler sheets, broken frames and cylinders. All new piston rods are hammered out of scrap axles. Loose fits in crossheads and piston heads are built up with acetylene, annealed and refitted for re-use. The same process is employed by using bronze and then turning to the proper size, in building up cast iron piston heads that are worn too small for the cylinder. Worn crank pins are set aside and turned down for smaller sizes. New crank pins are forged out of scrap driving axles; loose axle fits are built up, annealed and refitted to rebored wheels, and worn or sharp flanges on driving or engine truck tires are built up with the electric process. New fireboxes are applied with all seams electrically welded and the only riveting performed is at the mud rings. There are 75 of these fireboxes in service to date, including two Mallet type. Application of the side sheets, as well as boiler sheet repairs, are generally taken care of by this method. In fact reclamation of parts in this manner is general where consistent with safety and where a reduction in the expense for material can be made.

The shops are equipped with an acetylene generating plant, and all parts of the plant are piped with drop lines, thus eliminating the trucking of gas cylinders.

Shop Organization

The organization of these shops under normal working conditions is as follows:

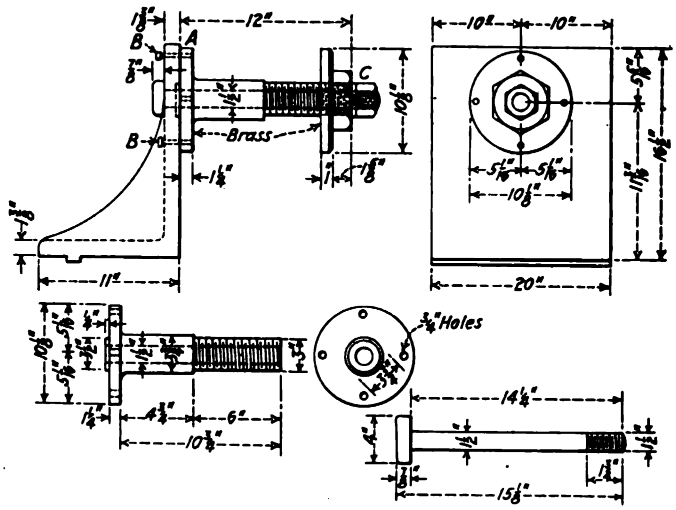
1 Superintendent of shops
1 General foreman
2 Erecting foremen
1 Machine foreman
1 Pipe and tin foreman
1 Boiler foreman and 1 assistant
1 Carpenter foreman
1 Blacksmith foreman
1 Rod and motion work foreman
1 Driving box and wheeling foreman
1 Air brake foreman
1 Painter foreman
1 Cab work and boiler mounting foreman
1 Stripping and wheeling foreman
1 Toolroom foreman

The jurisdiction of the superintendent of shops, general foreman, and boiler foreman is also extended over the 32-stall enginehouse adjacent to the shops. The total normal working force is 587, including the supervisory officers and the monthly output consists of 20 general repairs, including an average of three fireboxes per month.

Swivel Chuck for Rod Brasses

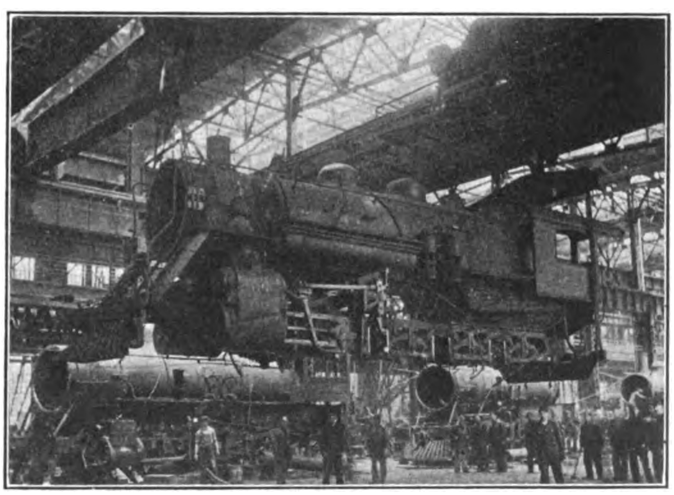
A SWIVEL chuck for holding rod brasses that are bolted to the bed of a shaper or planer is shown in the sketch. It is so designed that a brass may be machined on all four sides and at any desired angle.

The chuck consists of a clamp and bracket with a base

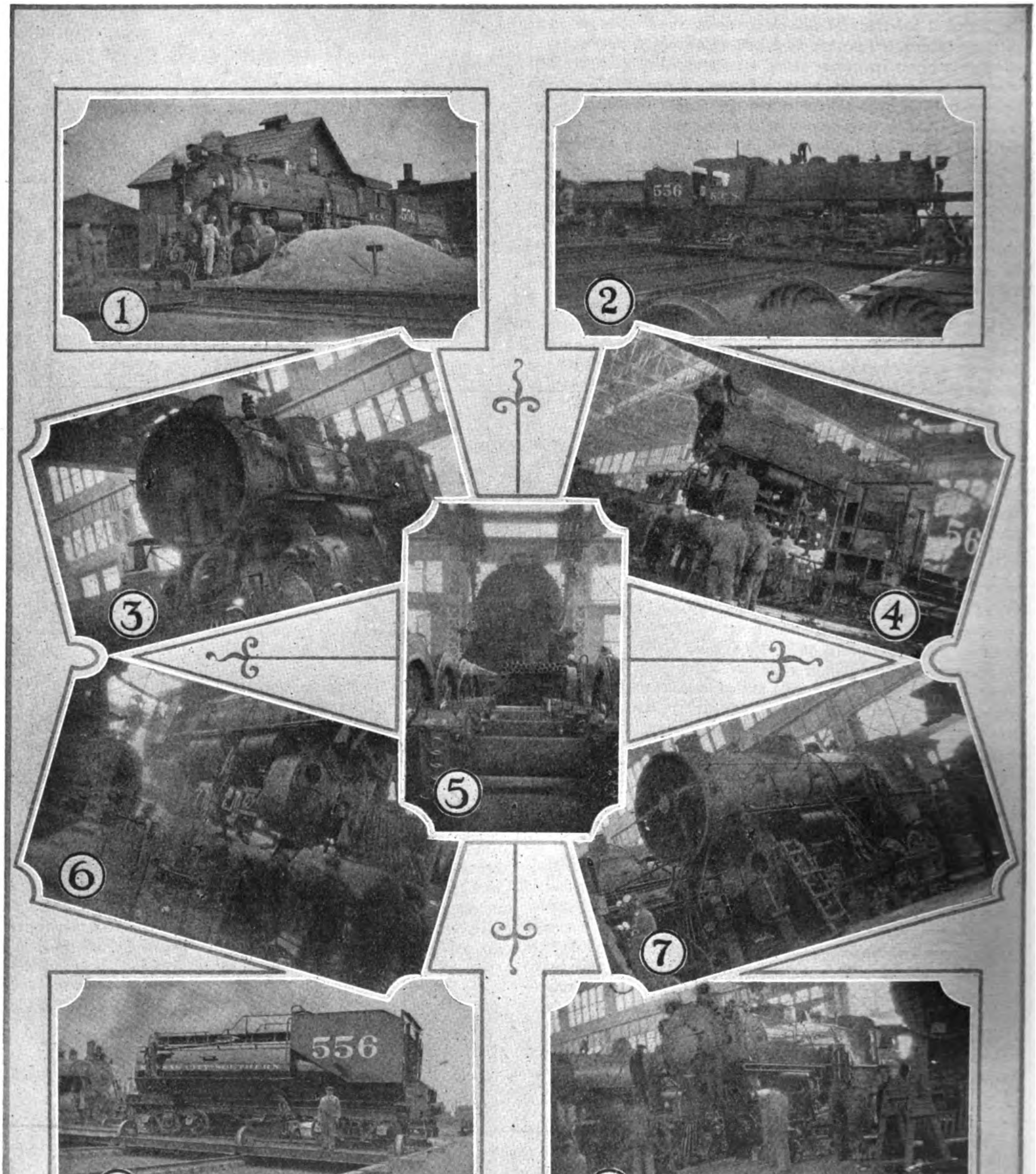


This Device Holds a Rod Brass So That It Can Be Machined on All Four Sides at One Setting

11 in. by 20 in. and a face 16½ in. high. It is fastened to the bed of the machine by four bolts. The brass is secured to the face of the chuck by means of a clamp that is provided with two jaws, as shown at *A*. This clamp is held to the face by a 1½-in. bolt with head 4 in. square and ⅞ in. thick. The stationary jaw is provided with four ¾-in. holes that correspond in position to similar holes in the face. The pins *B* are inserted in these holes to prevent the clamp from turning. When it is desired to turn the brass, it is only necessary to pull the pins and loosen the nut *C*. The clamps *A* do not need to be touched until the entire job is finished. This feature permits uniformity on all four sides and no further adjustment for accuracy is required after the brass and chuck has been once set up.

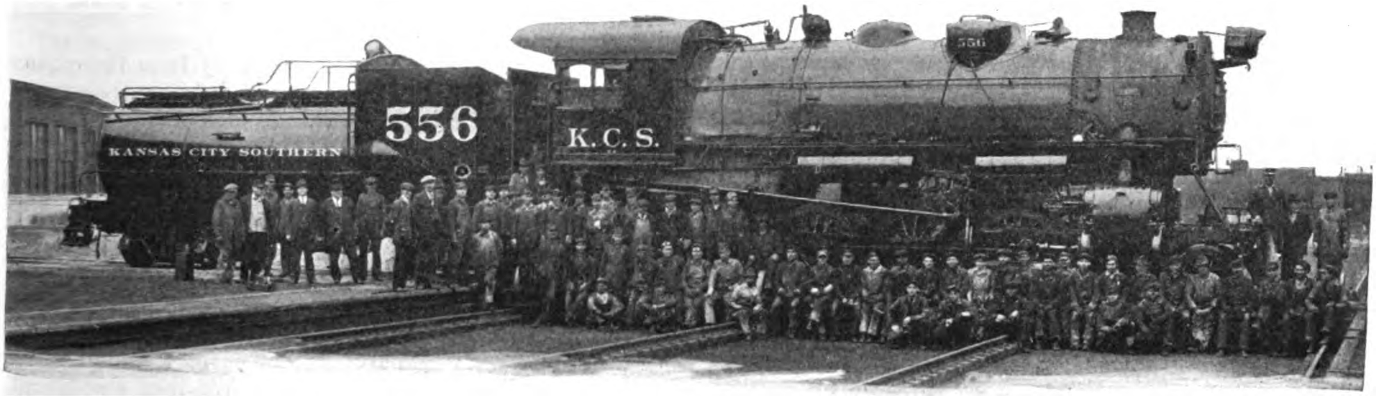


Interior View of the Erecting Shop at Billerica, Mass., on the Boston and Maine



1—Locomotive at the Transfer Table, 8:01 A. M. 2—Moving Over the Transfer Table, 8:03 A. M. 3—Front End Door Ring Removed, 8:26 A. M. 4—The Locomotive Unwheeled, 8:52 A. M. 5—Part of the Tubes Removed; Duplicate Drivers and Boxes in the Foreground, 10:10 A. M. 6—Starting to Wheel the Engine, 10:32 A. M. 7—Condition of the Engine at Noon, 12:02 P. M. 8—Tender on the Transfer Table, 3:30 P. M. 9—Applying the Front End Door Ring, 4:18 P. M.

K. C. S. Makes Class 3 Repairs Within Eight Hours



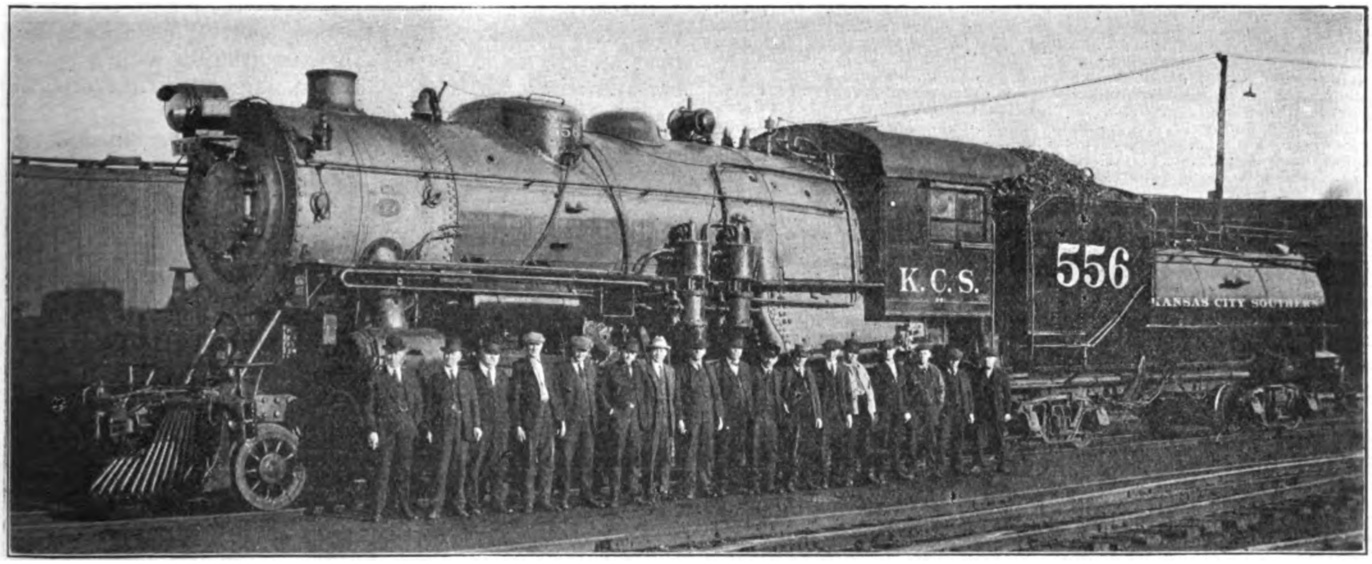
Shows Possibilities of Modern Facilities, Co-operation and Separation of Repairs and Erecting

TIME records for making Class 3 locomotive repairs on the Kansas City Southern were broken on March 17, 1924, when locomotive No. 556 was given Class 3 repairs in the shops at Pittsburg, Kans., in 7 hrs. 55 min.

Locomotive No. 556 is a heavy 2-8-0 type, coal-burning engine used in freight service and known as Class E-4. The locomotives of this class were built in 1913 and have the following principal weights and dimensions:

Weight of locomotive, loaded	254,000 lb.
Weight on drivers, loaded	224,000 lb.
Weight on tender, loaded	172,200 lb.
Wheel base, engine	26 ft. 10 in.
Wheel base, engine and tender	66 ft. 9 in.
Cylinders, diameter and stroke	26 in. by 30 in.
Diameter of driving wheels	57 in.
Tractive force	55,948 lb.
Boiler pressure	185 lb.
Boiler, inside diameter, first course	82 in.
Firebox, length and width, inside	108⅛ in. by 83¼ in.
Tubes, number and diameter	219—2¼ in.
Flues, number and diameter	38—5½ in.
Length over tube sheets	15 ft. 6 in.
Valve gear	Walschaert
Piston valves	14 in.
Tender capacity, water	9,000 gal.
Tender capacity, coal	17 tons

Shop facilities at the division and shopping points have been greatly augmented in recent years. Especially is this true at Pittsburg where extensive additions have been made in the way of buildings and machinery. To test the resources of the Pittsburg shop and to better the records of similar projects recently carried out by the Southern Pacific and Delaware & Hudson, the management decided to make Class 3 repairs on a heavy locomotive in eight hours or in a shorter time if possible.



Officers and Supervisors Responsible for Giving This Locomotive Class Repairs in 7 Hr. 55 Min.—M. A. Hall, Superintendent of Machinery, at the Left

On January 7, the general plans were formulated by M. A. Hall, superintendent of machinery, in conference with J. W. Chandler, master mechanic; R. Skidmore, shop superintendent; William Nelson, mechanical engineer, and C. Y. Thomas, supervisor of apprentices. Three weeks previous to shopping the engine, Mr. Hall, through the foremen and the shop council, completed the program of procedure, and the foremen were informed of their specific duties so as to reduce the confusion incidental to a performance of this kind.

Class 3 repairs includes parts of firebox sheets renewed, or firebox patched; an entire set of new driving wheel tires, or an entire set of driving wheel tires returned; an entire set

of new boiler tubes applied, or an entire set of boiler tubes repieced and reset; all driving wheels removed and general renewals and repairs to the boiler, firebox, cylinders, steam pipes and chests, frames, running and motion gear, bearings, air brake and other special equipment, trimmings, draft gear, tenders, etc., and repainting.

To expedite this work a number of duplicate engine parts were in readiness previous to March 17, such as retired driving and engine truck wheels, driving boxes with new bearings, side and main rods with bushings, crossheads and pistons, link work (except trunnion bushings), brake rigging, etc.

How the Work Was Done

The locomotive was moved into the shop at 8.05 a.m. After stripping, the engine was picked up by the 250-ton crane and carried to another pit where the various repairs proceeded, such as welding a broken deck casting, rolling in 219 tubes and 3 flues, changing the air cooling pipes from near the firebox to the front part of the engine, applying main and side rods, etc. In addition to the above mentioned work, two new piston heads were applied and new cylinder packing fitted, one piston rod was turned and one new piston rod applied, four new crosshead gibs were applied, two new crosshead pins turned, eight new valve rings were cut and spotted and eight new shoes and eight new wedges machined and fitted.

The progress of the work on the locomotive while in the shop is shown in the following tabulation:

Engine awaiting movement into shop	8:00 a.m.
Engine moved on transfer table	8:03 a.m.
Engine moved into shop	8:05 a.m.
Cylinder heads and piston valve heads removed	8:15 a.m.
Dome cap removed	8:16 a.m.
Tender detached	8:17 a.m.
Headlight removed	8:20 a.m.
Main rods taken down	8:25 a.m.
Front end door ring removed	8:26 a.m.
Driving brake rigging taken down	8:30 a.m.
Pistons taken out of cylinders and crossheads taken down	8:31 a.m.
Binders taken down	8:40 a.m.
Piston valves pulled	8:45 a.m.
Links removed	8:46 a.m.
Engine unwheeled	8:52 a.m.
Engine swung in crane ready to move to adjoining pit	8:57 a.m.
Throttle box removed	9:00 a.m.
Engine moved to other pit	9:05 a.m.
Nozzle stand removed	9:15 a.m.
Crossheads put on	9:30 a.m.
Flues, removal started	9:31 a.m.
Tender trucks removed	9:32 a.m.
Pistons put in cylinders	9:50 a.m.
Wheeling, started at	10:32 a.m.
Tubes removed	10:45 a.m.
Driving and engine truck wheels under engine	11:00 a.m.
Tube setting started	11:05 a.m.
Air pumps applied	11:45 a.m.
Links hung	11:46 a.m.
Trucks placed under tender	11:47 a.m.
All binders put up in place	2:00 p.m.
Engine trammed and changes made in shoes and wedges	3:00 p.m.
Boiler tested	3:30 p.m.
Main and side rods applied	3:35 p.m.
Nozzle stand applied	3:45 p.m.
Valve motion set up	4:00 p.m.
Cooling pipes applied	4:05 p.m.
Throttle box and dome cap applied	4:15 p.m.
Front end door ring applied	4:18 p.m.
Front end closed	4:30 p.m.
Valve setting completed	4:45 p.m.
Engine pulled out of shop	4:50 p.m.
Tender connected	4:55 p.m.

The engine was broken in very satisfactorily the following day, March 18, and went into regular service at 3.55 a. m., March 19, when it departed from Pittsburg for Kansas City, hauling a full tonnage train.

There have been no hot boxes on the engine or tender, nor hot side or main rod bearings and no failures due to steaming have been reported.

With the unreserved co-operation of the mechanics, apprentices, helpers and laborers, who bent all efforts towards the completion of the project, the work progressed smoothly and was completed without serious difficulty. Everyone concerned had deep interest in the work and this interest and loyalty has caused the management to look towards a future proposition of making Class 1 repairs on a Consolidation or Pacific type locomotive in six days.

Valve and Valve Gear Repairs*

By J. H. Armstrong

Assistant General Foreman, Atchison, Topeka & Santa Fe, Topeka, Kans.

AFTER all valve gear parts are removed from the engine at Topeka shops, they are placed in a crate, sent to the lye vat and thoroughly cleaned, then being delivered to the motion gang where all parts of the valve gear, side and main rods, crossheads and guides are repaired.

The foreman in charge and a mechanic inspect all parts for defects and worn places, and all parts are checked up for proper blue print lengths. If any parts are found to be incorrect, we send them to the blacksmith shop and they are altered in accordance with the blue prints.

Worn places on the valve gear parts are electric welded and faced with a jig we have for that purpose which makes the faces square with the pin holes. We then rosebit all holes, fit new brass bushings and straight ream the brass bushings to the standard sizes for the pins.

If we find any of the flaws with too much lateral, we close the jaws to suit. All new motion pins are turned, drilled for dowels, threaded and sent to the blacksmith shop for case hardening. The links also are hardened, after which they are ground to a templet with the proper radius. Link blocks are ground on the radius face and pin holes.

Eccentric cranks and blades, eccentrics and straps are repaired in a similar manner. All main axles on Stephenson valve gears are laid out to a templet and all eccentrics keyed on before wheeling in the engine. If new axles are applied, the keyways are milled for the eccentrics with a milling machine.

All valve bushings are inspected to see if they are round, with ports spaced according to blue print. They are checked for size. If found out of round, we true up with a boring bar and renew when worn 3/16 in. larger than the original size.

All valve chamber bushings which must be renewed are chipped out with air hammers, our experience showing this to be the best method so far developed. Before applying new valve bushings we caliper all the valve chamber ribs to see if they are round and of the same size. If they are not we bore the valve chambers before the bushings are fitted. All valve chamber and cylinder bushings are pulled in the cylinder with a hydraulic bushing inserter, the time required being about 30 minutes a bushing.

The gang foreman on the erecting floor applies all rocker boxes, tumbling shafts, links, valve gear parts and valves, also power reverse gears or reverse levers and quadrants. Valves are set by one mechanic, one apprentice and a helper. We have an air-driven machine to roll the wheels in the forward or back motions in order to square and set all valves to the prints on different class engines.

If we find an engine carrying 1/4 in. lead and 5 in. valve travel and the print calls for 3/16 in. lead and 5 3/4 in. valve travel, we make the proper changes to set the valve according to blue print instructions.

Piston valves are stripped complete and each part stencilled. The stems are calipered for the scrapping limit. The bullrings, spiders and bodies are sent to the sand blast to have the carbon removed. After returning from the sand blast, the bodies are calipered for length and also to see if they are parallel. If not, they are welded and faced square and for length on the boring mill. The spiders are sent to a lathe and the ring seats faced square. The valve stems are trued, threads on the end rechased and dowel pins and cotter key holes redrilled. The valve stem keys are fitted to the crossheads or valve rods.

As soon as the valve bushings are bored, they are calipered

*From a paper presented before the 1923 convention of the International Railway General Foremen's Association.

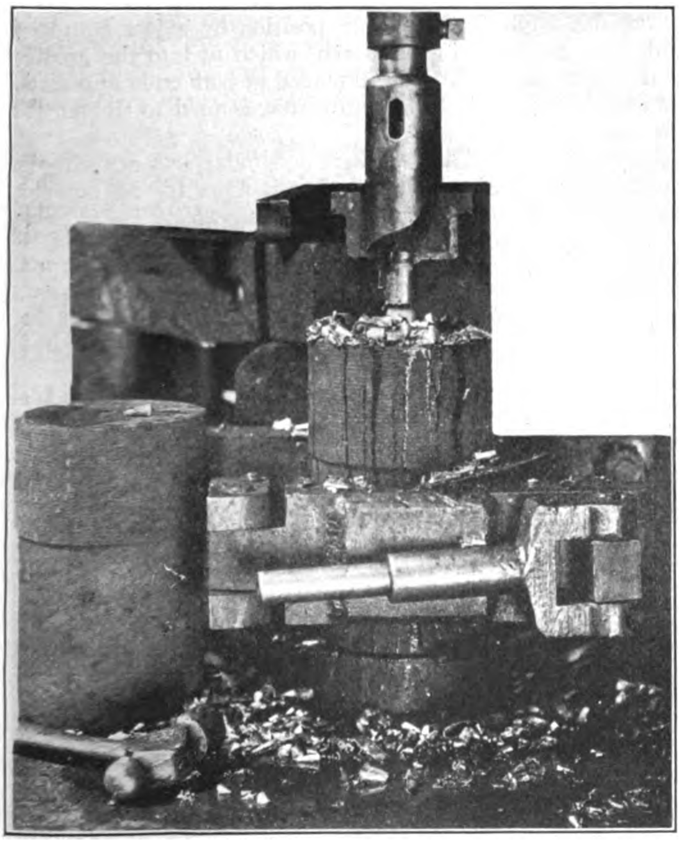
and the bullrings are turned to fit the bushings, old bullrings being used wherever possible. After the bullrings are turned, the rings are fitted to the cylinder. One ring is fitted to each bushing and the remainder are fitted to a bushing tub at the bench. After the rings are fitted to the cylinder, the valve is assembled.

The rings are fitted to grooves in the bullring to see if they have the proper amount of lateral. Then the small bullring keys are fitted to the spider and the bullring. The spider rings and bullrings of the front end of the valve are laid on two small blocks on the floor and the body is placed on top. The same process is followed for the back spider bullring and rings as previously stated and then they are placed on top of the body. The stem is dropped through the spiders and body and driven in place with a light sledge. A castle nut is screwed on the end of the stem and the valve is then laid on the floor and the nut tightened with a wrench.

The valve is checked for length inside and outside of the rings, for admission and exhaust opening, lateral of rings and for squareness of the valve. If found correct it is ready to be applied to the valve chamber.

Saving Operations in Finishing Crank Pins

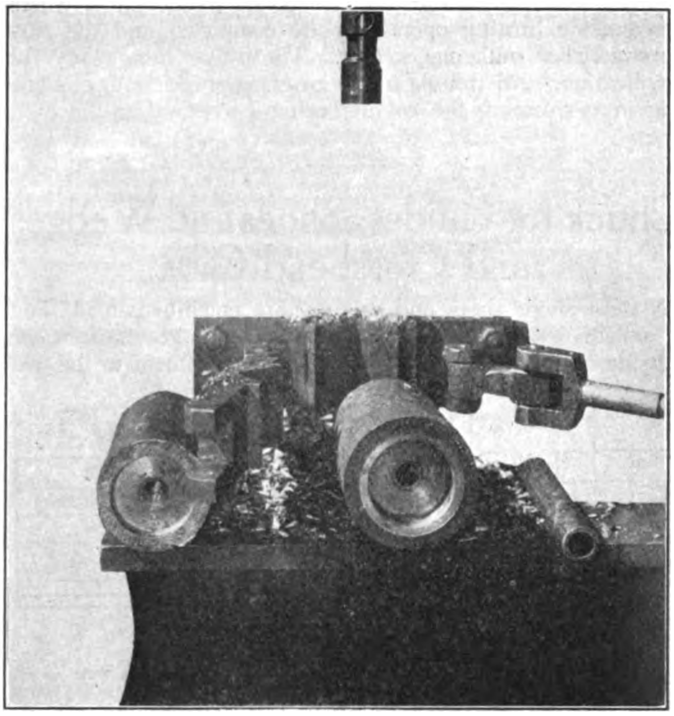
A METHOD of machining crank pins, described in the April issue of the Norfolk & Western Magazine, has been developed by U. V. Garred, efficiency engineer, and F. H. Wicks, gang leader in the machine shop, which requires but one setting of the pins on the drill press and one setting in



The Use of the Counterboring Tool Shown Here, Is Followed by the Tapping Operation

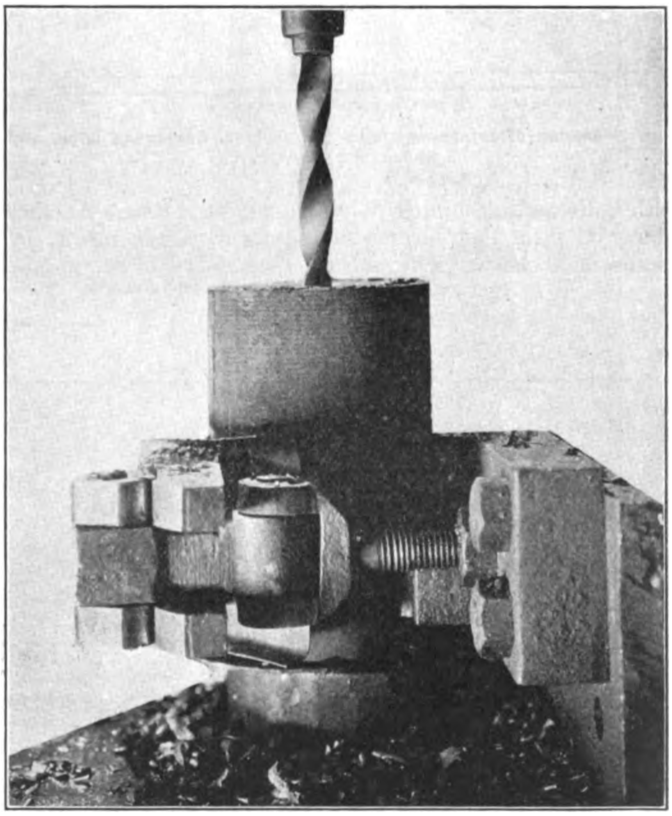
the lathe, and by which has been effected a saving of 35 min. in the time required for completely finishing a crank pin.

Before this method was developed, the pin was first set up in the drill press and the hole drilled in the center for the collar bolt. The pin was then set up in a lathe and the outside turned to size and polished. A steady rest was then used to support the pin while the counterbore for the collar



The Chuck Open, Ready to Receive the Crank Pin

was finished, after which the bolt hole was tapped out. In many instances it was found that the steady rest had scored the surface of the pin so that repolishing was necessary.



Special Drill Press Chuck for Holding Crank Pins While Drilling and Counterboring for the Collar Fit

By the use of a special chuck on the drill press the pin is now quickly set up for the drilling operation. When this

is completed, a special counterboring tool is placed in the drill spindle and the collar recess refinished in one operation. The tap is then placed in the drill spindle and the bolt hole tapped, after which the pin is removed to the lathe, where the outside turning operations are completed and the surface polished with one setting. The pin is then ready for application. No trouble has been experienced from chattering in performing the counterboring operation on the drill press.

Chuck for Guides, Shoes and Wedges and Crosshead Gibs

In most shops shoes and wedges are machined inside and outside by two planers. One planer is used to machine the outside of the shoe and wedge by clamping them to the bed

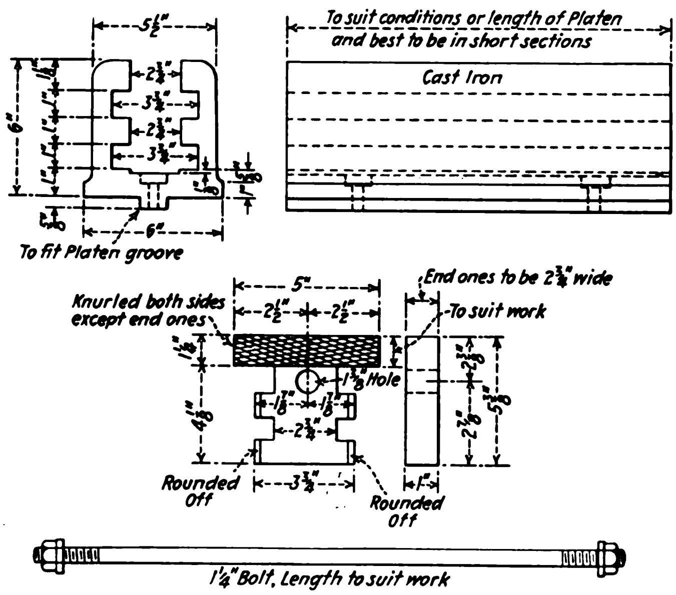


Fig. 1—Sketch of Improved Chuck for Guides, Crosshead Gibs, and Shoes and Wedges

with bolts and machining only one side at a time. Another planer is then used for machining them on the inside, by means of a chuck. This makes it necessary to set up the shoes and wedges three different times before the job is completed.

Either of the two chucks shown in the sketches will hold an entire planer platen full of shoes and wedges so that they may be machined complete inside and outside in one setting. By using both heads and double tool posts on each head, a set of shoes and wedges can be machined as quickly

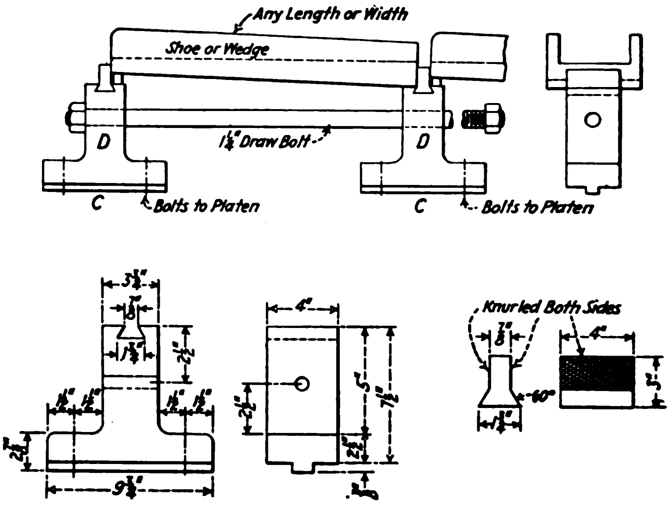
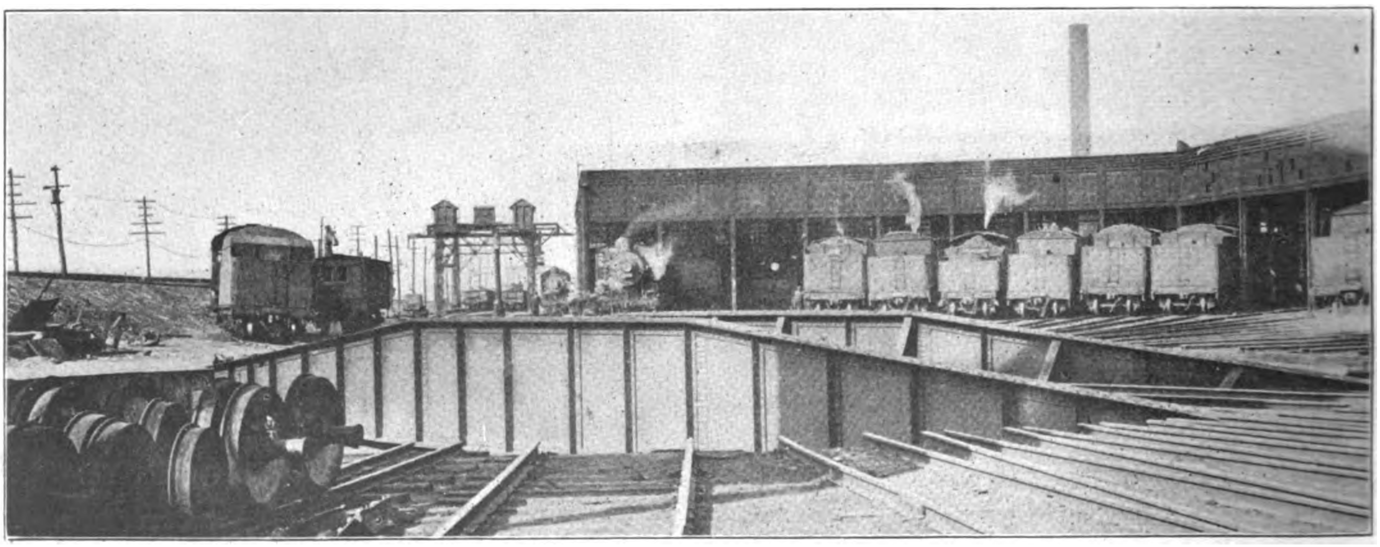


Fig. 2—This Chuck is Simple in Construction and Can Be Easily Adjusted

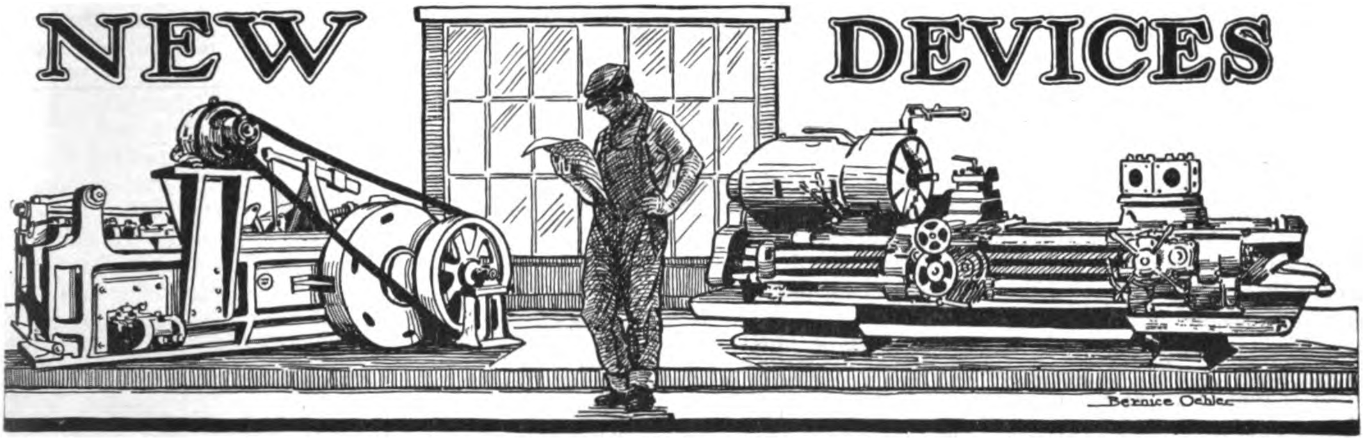
as a set can be machined on the outside by the common method.

The chuck, Fig 1, consists of a cast iron base provided with annular grooves, which is bolted to the platens. A guide or crosshead gib is clamped in position by a jaw equipped with lugs, as shown in the sketch, which fit into the grooves of the base. A 1¼-in. bolt, threaded at both ends and made sufficiently long to hold an entire row, is used to tighten the jaws against the work.

Both chucks hold the work in a similar manner but the chuck shown in Fig. 1 is somewhat handier for an operator because the bolts *C*, used on the chuck shown in Fig. 2, must be loosened at each setting in order to have the standards *D* set along the platen to suit the length of the work. Either of these chucks is an improvement over the old method and they will hold any job, such as guides, shoes and wedges, crosshead gibs and similar work, in a satisfactory manner.



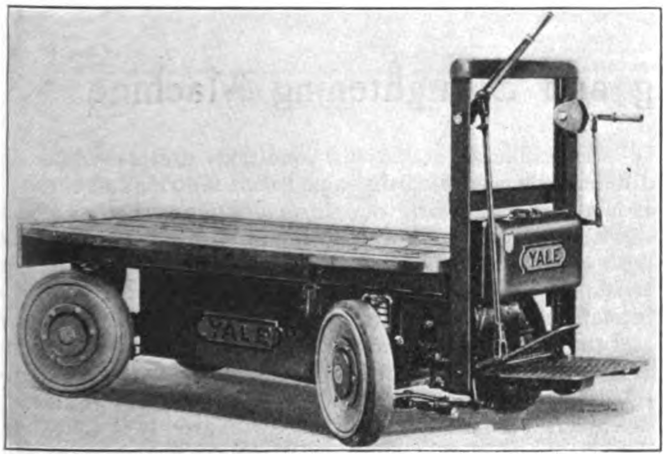
Modern Rectangular Type Enginehouse of the New York, New Haven & Hartford at Boston (Southampton Street), Mass.



A Complete Series of Industrial Trucks

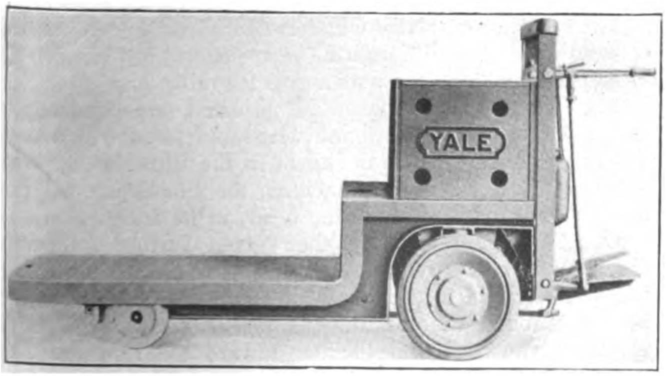
THE Yale & Towne Manufacturing Company, Stamford, Conn., is manufacturing five new types of industrial trucks, known as the K-20 to K-24, inclusive. This set constitutes a complete series of trucks, each of which is designed to fill a definite place in the scheme of material handling around a railroad shop.

The K-20 model is designed to meet the general require-



Model, K-20, High Platform General Utility Truck

ments of intraplant movement. It will handle miscellaneous units of material which may be placed on the platform by hand, hoist, or overhead crane service. The auxiliary equip-

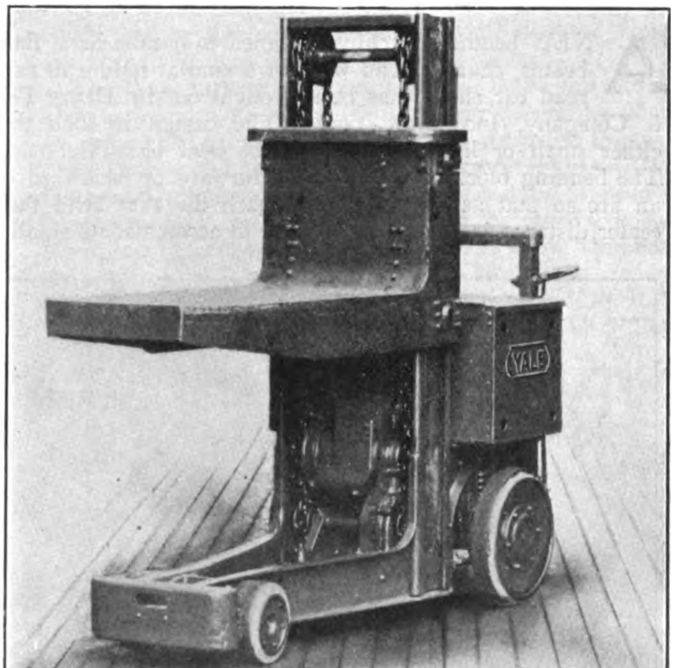


K-23 Is a General Utility Truck Built for Heavy Duty

ment designed for it includes a gravity dump body for handling loose material and an electrically operated swinging boom crane. It has large wheels and full spring suspension which permits of operation over rough surfaces. The controlling mechanism is especially constructed to facilitate handling in narrow aisles and congested places. All parts are easily accessible and are grouped in self-contained major units. The truck has a rated carrying capacity of 4,000 lb. and can be turned in a radius of 91 in. The wheel base is 58 in. and the overall length is 102¼ in., with an overall width of 84 in.

The model K-21 truck is similar in form to the K-20, but is equipped with a wider platform.

Model K-22 is a self-loading transportation unit in which



The Elevating Platform Truck, Model K-22, Is a Self-Loading Transportation Unit

are combined the advantages of high and low lifting. It may be used to lift loaded skids from the floor, transport them to a given place and raise them to a higher level in order to facilitate stacking or tiering in a storeroom or freight car. This model has a low center of gravity and the longitudinal frame members are made of pressed steel, which permits it to carry a 4,000-lb. load. The lifting and lowering mechanism is of the triple, spur-geared reduction type, electrically driven. It is equipped for electric braking and has a mechanical aux-

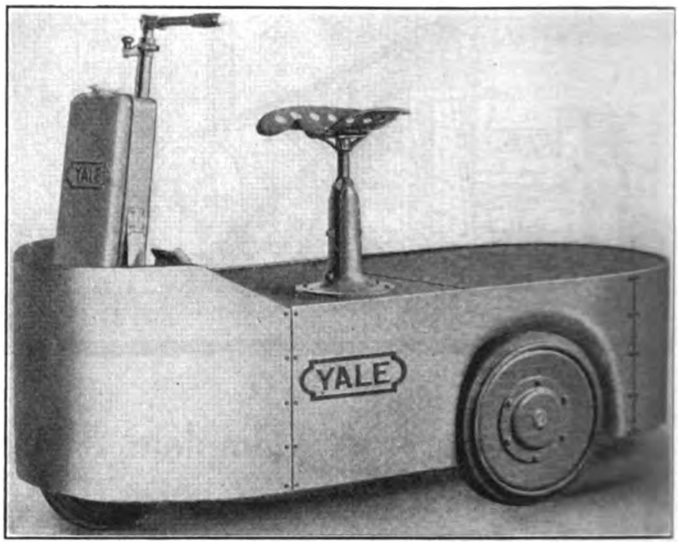
iliary lowering-speed control with automatic upper and lower limit stops.

The Model K-22 truck has a wheel base of 55 in. and the overall height is 105 in. It can be turned in a radius of 84 in. and will travel at a speed of 6¼ miles an hour on a level concrete roadway, with a load of 4,000 lb.

The Model K-23 is a general utility truck and is designed with a low platform to reduce heavy lifting to a minimum. It is built for heavy duty and for operation where the road surface is in average good condition. Its overall length is 110¼ in. with a wheel base of 55¼ in. and can be turned in a radius of 89 in.

This company has also placed on the market a three-wheel truck known as K-24. Its platform area of 15 ft. is 70 per cent of that of the Model K-20 truck. It is capable of passing through a 3-ft. doorway, and may be carried on a 7-ft. elevator. This machine has a low center of gravity which is designed to prevent bucking, overturning against stalling loads, or tipping over sidewise while rounding a corner. The frame is made of heavy pressed steel and contains the battery compartment, bumpers and deck, which makes a solid and rugged one-piece structure. It is suspended on helical springs over each wheel. The seat is further protected by an additional spring of the swivel type, which enables the operator to get on or off the machine with greater facility and to look or reach back to the coupling point. The clear deck gives him unobstructed vision of the drawbar, which is essential for safe fast operation.

With the exception of the Model K-24, the various parts of these trucks are interchangeable with each other. The five trucks are equipped with spur-geared unit power axles

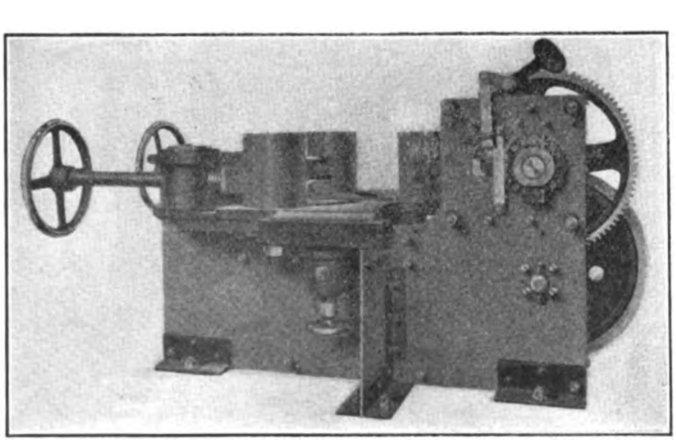


Model K-24 is a Combined Tractor and Truck for Operation in Congested Spaces

which are identical and interchangeable with all of the trucks of the K series. Heat-treated alloy steel and ball bearings are used throughout.

A Horizontal Eccentric Bending and Straightening Machine

A NEW bending machine designed to handle bars, flats, beams, channels and work of a similar nature in railroad car shops, has been brought out by Henry Pels & Company, Inc., New York. The design is such that either small or large sections can be bent or straightened. The bending blocks may be moved forward or backward on an arc so that as the blocks approach the ram head their center distance is shortened in order to accommodate smaller



Machine for Bending or Straightening Heavy Channels

sections and shorter radius curves. As the blocks recede from the ram head, their center distance is increased to accommodate larger sections and longer radius curves.

With this arrangement it is unnecessary to make a special adjustment of the bending blocks to suit the size of each section to be bent. The arc lines of travel of the bending blocks have been determined from the moment of resistance of various sections as well as from results of actual tests. It has been found that for practical reasons a beam cannot be bent with blocks as close together as would theoretically be permissible, and that the conditions are also materially different when bending the same beams flatwise and edgewise. It has also been found that in determining whether a beam can be bent on a machine, it is not so much the weight of the section that should be considered as its shape moment of resistance. For bending rails or similar heavy sections, it is recommended that blocks be used between the ram head and the section itself.

The construction of this bending machine embodies the same features as the other lines of punching and shearing machinery manufactured by this company. It is constructed with heavy steel plate frames of special analysis and high tensile strength and the design provides a high factor of safety. The gears are made of steel with machine cut teeth all pinions and shafts are forgings. The bearings are of liberal dimensions and are provided with phosphor-bronze bushings. The main shaft bearings are equipped with ring oilers.

The table is especially wide and substantial to insure ease of handling. In addition, it has a horizontal roll on each side to facilitate pushing the bars across the table.

The bending blocks can be adjusted independently of each other by means of a hand wheel and screw which moves them in the arc groove, as shown in the illustration. When a beam is placed in the machine, the blocks are adjusted toward the ram head until the head, in its travel, starts the bending. The blocks are then given further adjustment until the desired curve is obtained and when this adjustment has been completed, the length of section to be bent can then be fed through the machine as far as necessary. As the blocks advance around the arc toward the ram head, the center distance between them decreases. Thus any danger of overloading the machine is eliminated as the beam has lost part of its resistance against bending as soon as the first slight bend has been made. These machines are said to be rapid in operation and to have small power consumption. The space required is comparatively small.

Washburn Side Frame for Arch Bar Trucks

The Baltimore & Ohio is using something over 40,000 arch bar truck frames of a unique design. The first of these frames were applied to the new equipment ordered in 1922, and they are now in service on box and gondola cars of 80,000 lb., 110,000 lb. and 140,000 lb. capacity. The side frames of the trucks referred to were designed by Edwin C. Washburn, assistant to the president of the Baltimore & Ohio.

The object aimed at in this design is to use as large a quantity of rolled material as possible and to take advantage of the merits of the arch bar type while eliminating its undesirable features. Rolled bars are low in cost and are of definitely known strength. But inasmuch as nearly a third of the arch bar material in the old M.C.B. design was removed to allow the introduction of the column bolts and, furthermore, as these holes were drilled near the bends of the bars, the frame was not as strong as the weight of material would warrant. In the Washburn design these points of weakness have been corrected.

A drawing and a photograph of 55-ton B. & O. truck frame, as manufactured by the Standard Steel Car Company, Butler, Pa., are shown in Fig. 1 and Fig. 2. The other two sizes are similar in construction, although differing in dimensions. In the 70-ton truck frame two 1⅛-in. pins are used on either side to connect the upper arch bar to the center casting.

A modified design is shown in Fig. 3. In this form the head castings are omitted and the ends of the arch bars are of the regular M.C.B. design and take the regular journal box and bolts. A third design is shown in Fig. 4. In this case the journal box and head casting are integral, the box being attached by a pin and cast steel filler at the top, the same as in Fig. 1. In both of these designs the center casting is riveted to the lower arch tie bars by means of 1-in. rivets, but as these rivet holes are some distance from the easy bend, the bars are not unduly weakened.

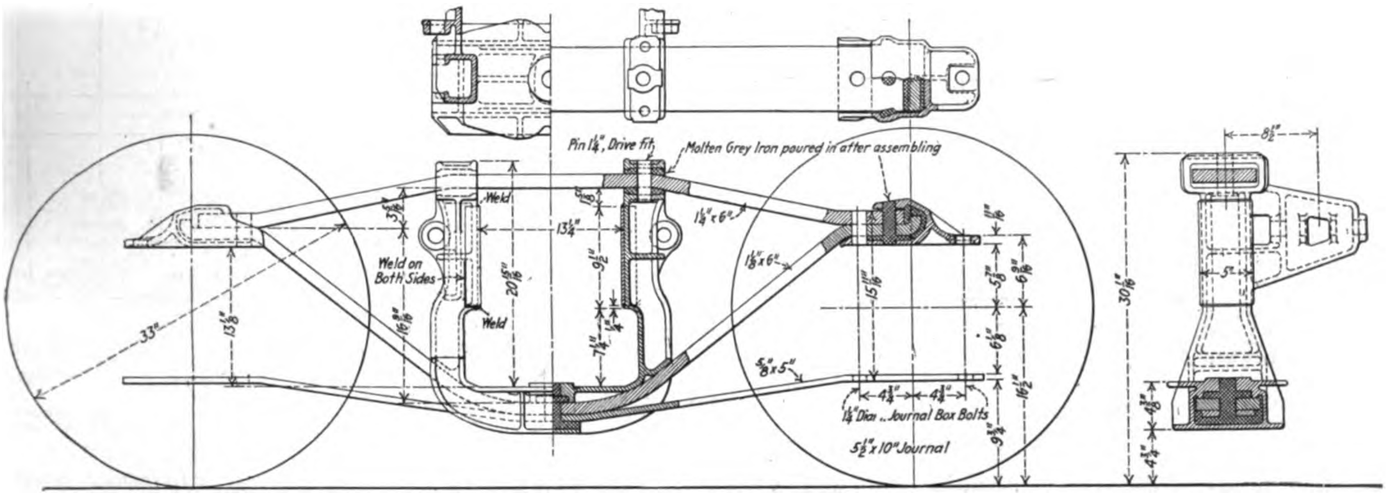


Fig. 1—55-Ton Washburn Truck Used on the Baltimore & Ohio

The Washburn side frames have the usual top and lower arch bars and a tie bar. The lower, or tension member has its end turned up and the upper bar is carried to this projection. To assemble the frame the bars are first passed through the center column casting, and the two recessed head castings, shown in Fig. 1, which fit over the journal boxes, or the special journal boxes shown in Fig. 4 are slipped over the ends of the arch bars. Rolled steel pins are driven through the arch bars and the heads of the columns and usually also through the bars and head castings. The as-

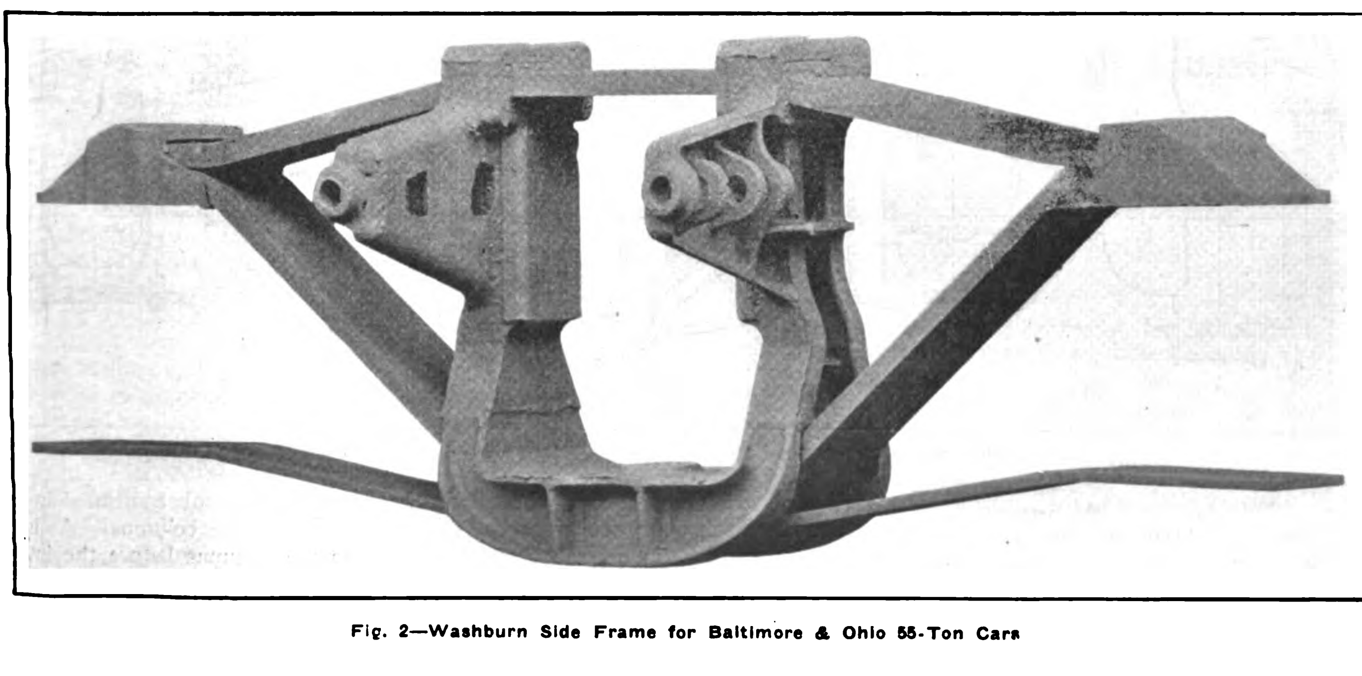


Fig. 2—Washburn Side Frame for Baltimore & Ohio 55-Ton Cars

sembling of the frames is done on jigs, thereby assuring accurate measurements and uniform wheel centers. Chills, or other material are used to stop up the openings, and cast steel or other suitable material is then poured into the upper

In the event of breakage of a head casting or an integral journal box, the defective part may be burned off and a new piece substituted, a new pin being driven in and the retaining metal poured into the cavities.

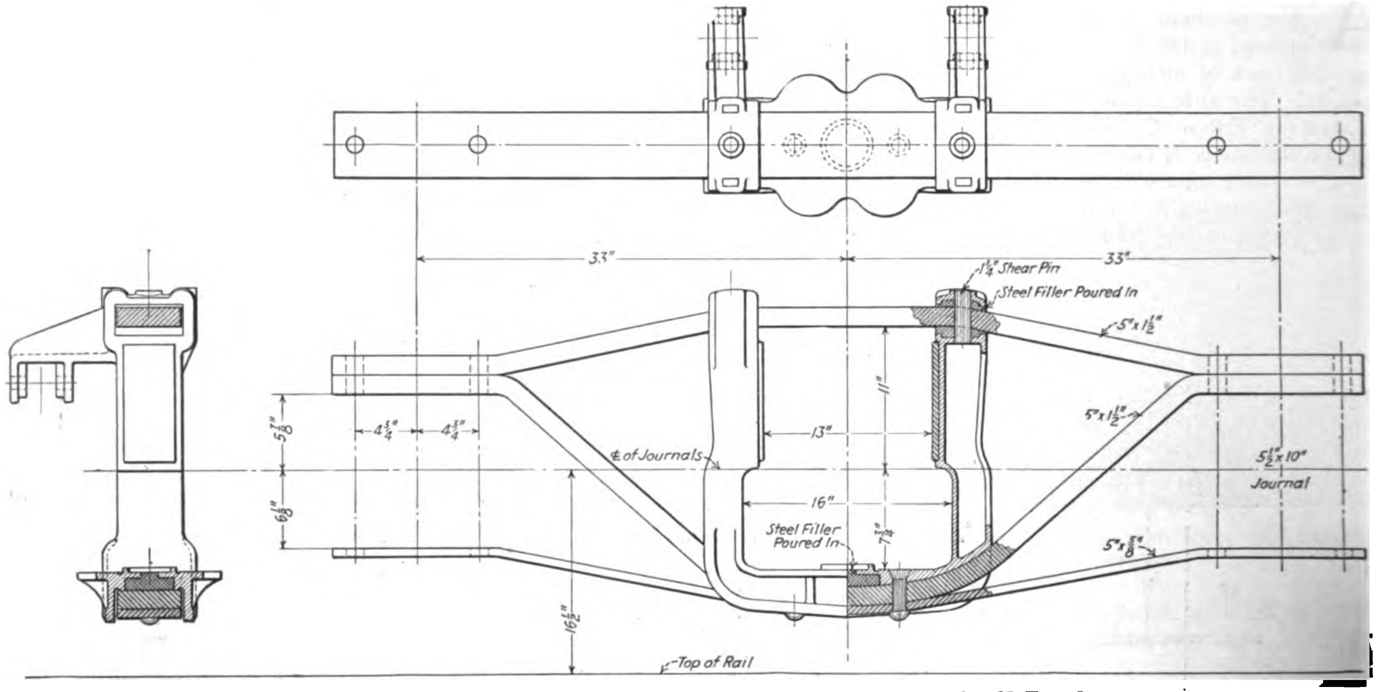


Fig. 3—Washburn Truck Side Frame with M. C. B. Arch Bar Ends for 55-Ton Cars

openings in the center column casting and in the recessed end castings. In most of the trucks cast metal has also been used to unite the center column and the lower bars. This gives a solid integral construction. It is not necessary that the filler material be fused to the bars as it forms simply a compression filler block which is cast in to hold the parts

These truck frames have shown very satisfactory results on the road as well as under drop and static tests, and when tested to destruction do not break, but bend. Should they become distorted by a wreck or derailment, they would still have sufficient strength to carry a load to the terminal.

A few of the earlier frames made did not have the bars

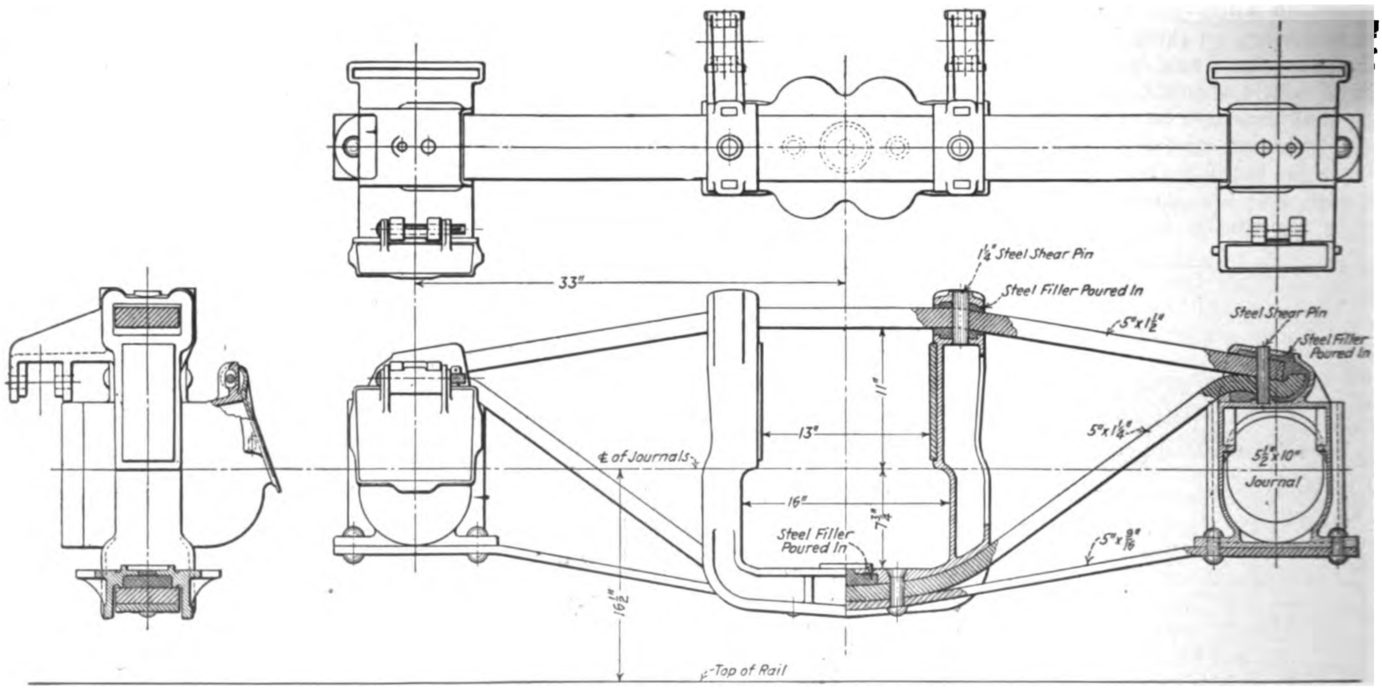


Fig. 4—Washburn Truck Side Frame of Journal Box Type for 55-Ton Cars

in position. Referring to the illustrations, it will be observed that the lower arch bar and also the tie bar are free from sharp bends. Where they pass under and leave the center column casting, the curves are of particularly large radius and the bars are not weakened by rivet holes. The construction is thus more reliable than the old M.C.B. design.

pinned to the column heads and as a result continued usage or wrecks had a tendency to spread the columns. As now made, the bars are pinned to the columns before the interlocking filler metal is poured in.

The sale of these frames is now being handled by the Duquesne Railway Supply Company, Pittsburgh, Pa.

A Pneumatic Flange Oiler for Locomotives

A PNEUMATIC flange oiler for lubricating locomotive and wheel flanges has been developed by the Hoofer Manufacturing Company, Chicago, and is shown in Fig. 1, applied to an Indiana Harbor Belt locomotive. By means of this device measured amounts of oil are fed to the wearing surfaces of the flanges by air pressure, at regular distance intervals. The oil is not sprayed on the flanges, but is gradually released from the oil shoes by an extremely small amount of air, vented through the oil pipes. This air acts as a preventive against stoppage in the oil shoes and

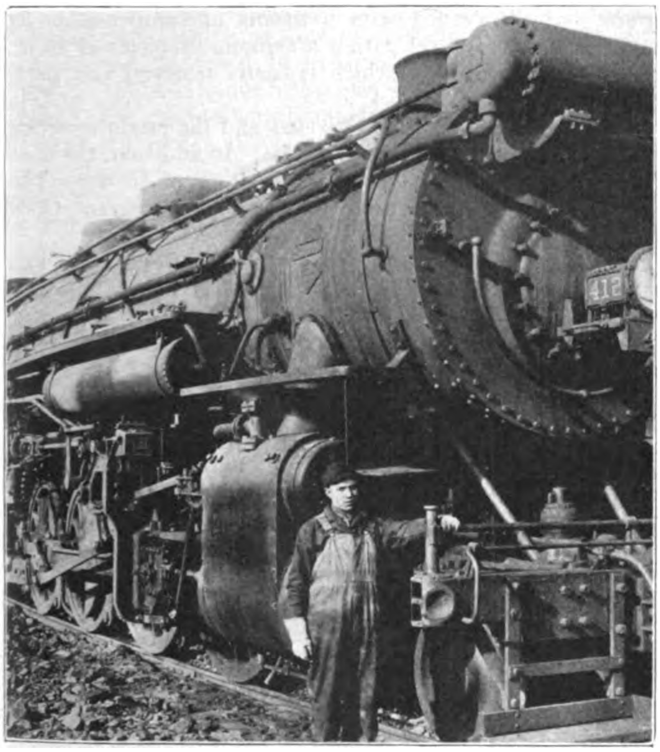


Fig. 1—Indiana Harbor Belt Locomotive Equipped with the Hoofer Flange Oiler

is designed to assume positive delivery of oil to the wheel flanges at the proper intervals.

Air pressure for the operation of the oiler is obtained through a pipe from the cab of the locomotive, where the air is comparatively free from condensation. A ratchet-type air control valve is installed in this line at a point where its control lever may be connected to receive a reciprocating motion from the radius bar or valve stem of the locomotive. The control valve is so designed that it opens and closes the air pressure supply to the lubricator once in every 100 revolutions of the driving wheels, and at these intervals the air pressure forces the discharge pistons downward into their respective oil cylinders at the bottom of the lubricator, causing a measured amount of oil to flow from the lubricator. At the same time a vent of air flows through the discharge pistons and carries oil through the oil pipes and the oil shoes to the flanges. When the air pressure is again cut off by the air control valve, the piston springs, convoluted about the discharge pistons, return them to their initial positions preparatory to their next lubricating operation. The amount of oil discharged at each interval may be regulated for each wheel separately. The oil cylinders, located at the bottom of the lubricator, are provided in various depths and are interchangeable so that one of the proper capacity may be substituted for another when required.

This lubricating system does not depend on any care or attention on the part of the engine crew. There are no valves to be manipulated either before or after the trip. The device is designed to be fool-proof. It functions only when the locomotive is in service, and stops when the locomotive is at rest. The pneumatic venting feature provides a circulation of warm air through the oil pipes and oil shoes which tends to raise the temperature of the oil and to allow the device to be used successfully in cold weather as well as in summer.

Proper distribution of oil is essential to successful flange lubrication, and the oil shoes shown in Fig. 2 have been especially designed for this purpose. The outlet passage for the oil is constantly maintained in contact with the side of the flange which wears against the rail, and thus the oil is supplied in a thin film on the part of the flange where it is most needed. The cast oil shoes, made of a special grade of white iron, are said to wear from 50,000 to 75,000 miles without renewal. The oil shoes are secured to their hangers by a tapered key, which may be easily removed when it becomes necessary to renew them. Hanger springs are designed to hold the shoes against the wheel flanges in a well balanced position at all times.

An important feature developed in the oil shoe rigging

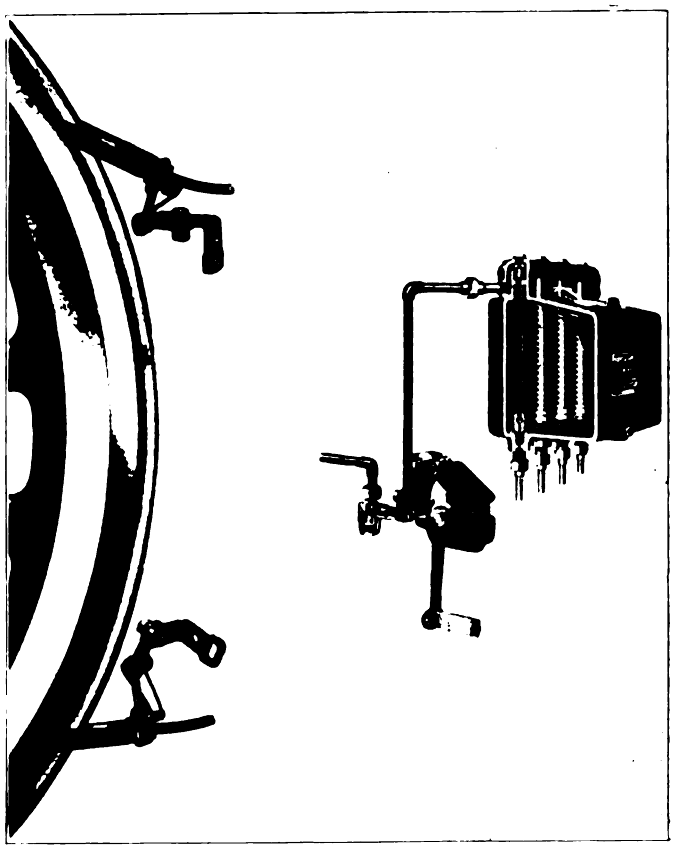


Fig. 2—Oil Shoes May Be Applied in Either of the Positions Indicated; A Section Through the Lubricator

permits of applying the shoes to the wheel flanges in either an incline or decline position as shown in Fig. 2. The pneumatic venting method of feeding the oil through the oil shoes is said to convey oil successfully to the flanges in either position of the shoe. The parts comprising the oil shoe rigging are designed so that they may be assembled in various combinations to accommodate the various ways in which they are required to be attached to the frames of locomotives of various types, or to car trucks and electric power.

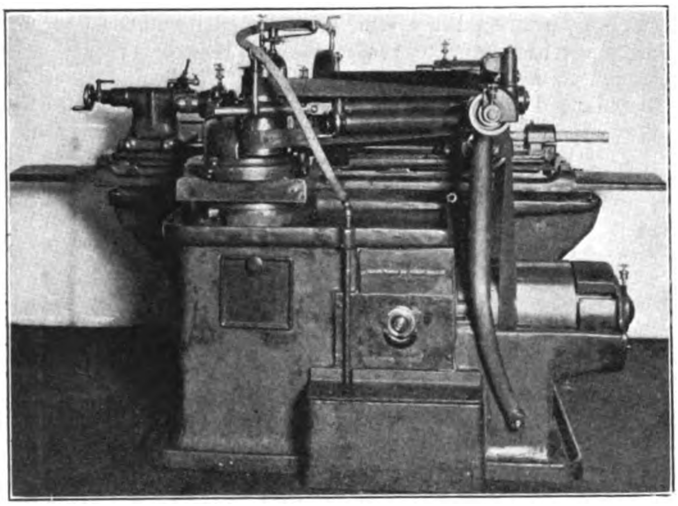
The Hoofer pneumatic flange oiler has been applied successfully to locomotives operating under severe conditions of.

flange wear, such as a long rigid wheel base and sharp road curves. Fig. 1 shows one of these lubricators applied to an Indiana Harbor Belt locomotive, 50 of which are equipped with this device. A test installation was also made on 20 locomotives of the Chicago Junction Railroad which has now adopted the Hoofer oiler as standard for all locomotives.

Universal Grinding Machine with Constant Speed Drive

A UNIVERSAL grinding machine of the constant speed drive type, known as the No. 2-1, is being manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I. It possesses all the advantages of a constant speed, self-contained drive and has a number of productive features built into its design, such as an independent automatic cross feed, quick traverse of the wheel slide, and an all-geared change speed and feed mechanism, which is a new feature of this line of machines.

The table and work is controlled by the hand lever shown slightly to the left of the center of the illustration. The same lever also actuates the brake for stopping the table. The various other controls are placed conveniently at the right and left of the operator that he may have entire control of the operation of the machine without having to change his position.



Rear View Showing the Self-contained Drive and Belting Arrangement

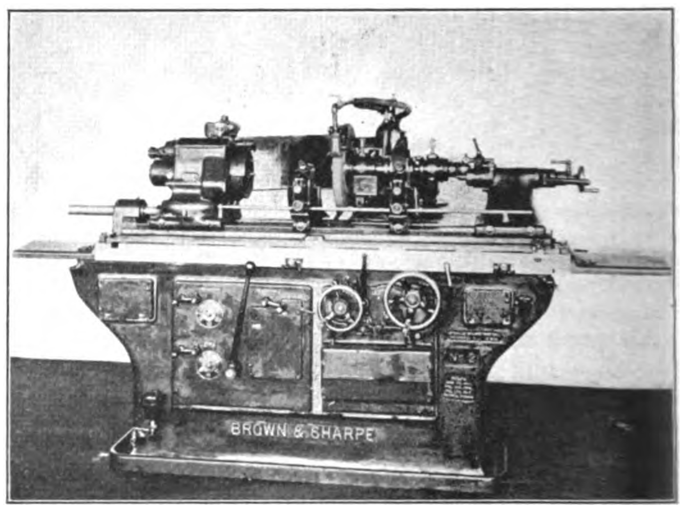
The constant speed, self-contained drive consists of a single pulley 8½ in. in diameter that carries a 4½-in. belt and is protected by a heavy belt guard. The driving shaft runs on ball bearings at a constant speed of 900 r.p.m. This arrangement dispenses with considerable shafting and belts, and also renders the machine adaptable for motor drive. At the rear of the machine on the main driving shaft is a wheel driving pulley, the face of which is made exceptionally wide to permit the travel of a belt, that compensates for the varying position of the wheel slide. The grinding wheel spindle is driven from this pulley by a belt running over horizontal idlers, mounted on roller bearings carried in a swinging frame, and vertical idlers mounted on the wheel stand. The swinging frame automatically provides for keeping an even tension on the belt, regardless of the position of the wheel spindle. An adjustment is also provided to take care of the stretch of the belt and split pulleys of different diameters used to obtain the various wheel speeds.

Contained within the base is an oil pump and tank which furnishes a constant supply of lubricant by means of pipes running directly to the various mechanisms. This system subjects the operating mechanisms to a constant deluge of oil, which, after passing over the various bearings, is returned to the tank. Bearings that are not automatically lubricated are provided with sight feed oilers or grease cups. The oil is automatically shut off when the table operating mechanism is stopped.

The wheel spindle is made of alloy steel. It runs in bearings that are hardened, ground and lapped, with self-alining bronze boxes provided with a means of compensation for wear. It takes a wheel with a maximum diameter of 14 in., ¾ in. to 1½ in. thick, which is easily removed and amply guarded.

The wheel slide may be swiveled and the angle of setting measured by graduations on the base. In addition, the wheel platen may be swung to a maximum angle of 10 deg. This feature enables the operator to grind two different tapers at one setting.

The hand cross feed and quick traverse is operated by a hand wheel located on the front of the machine. This hand wheel has two positions, one engaging the hand cross feed, and the other disengaging the hand cross feed and engaging the quick traverse. The automatic cross feed has a range of feeds from .00025 in. to .004 in. upon each reversal of the table. It is easily operated and can be set automatically to throw the feed out of operation as soon as the work has been reduced to the desired diameter. The wheel is fed to the work while the table is stationary by means of the independent automatic cross feed. At such times the table can be securely held from traversing by a safety lock which prevents the engagement of the longitudinal feed.



Universal Grinder Equipped With an All-geared Change Speed and Feed Mechanism

The table travels automatically on ways that are well proportioned to give large bearing surfaces. It turns on a central pivot bracket and can be set at an angle with the ways, which are protected by metal covers. Oil is evenly distributed as the table reciprocates by means of rolls turning in oil wells.

The table adjustment is indicated by a scale reading to 8 deg., 3½ in. taper per foot and 30 per cent. Clamps are provided to secure it at both ends and hold it rigid.

The speed of the wheel, the speed of the work and the feed of the table are entirely independent. Four changes of wheel speed are furnished, ranging from 1,500 to 2,400 r.p.m. There are also 12 indicated changes of work speed of 24 to

492 r.p.m. and 12 indicated changes of table feed that can be divided into two series, a slow series of 6 in. to 24 in. per minute, and a fast series of 33 in. to 128 in. per minute. These changes in work speed and table feed are readily available through the medium of two rotating levers conveniently located on the front of the machine. A dial beside each level indicates the speed or feed in operation.

The table can be stopped at any time during its travel by moving the lever located back of the table hand wheel. The reverse mechanism permits the work to be ground close to a shoulder and the table hand wheel is automatically disconnected while the power feed is in operation.

The headstock work drive plate is driven from the main driving shaft at the rear of the machine, through the clutch and speed cases to the transposing gears at the front. These transposing gears, which provide the fast and slow series of speeds, transmit the power to a splined shaft, upon which is mounted a splined sleeve contained within a bevel gear. This bevel gear meshes with another that is mounted upon a shaft contained within the central pivot of the swivel table. Power is transmitted through the bevel gears to a shaft mounted within the swivel table and then through two spur gears at the end of the table, one of which is mounted on the telescoping base shaft of the headstock. The drive from this telescoping shaft is through a series of bevel gears to a short shaft contained within the headstock, from which the final drive to the work driving plate is made by means of a silent chain.

The headstock swivels on a graduated base. It slides on ways and can be clamped at two points. The head spindle is 2 in. in diameter and is hardened, ground and lapped. The front end is threaded for 4½ R.H., U.S.S. thread, and the spindle is also provided with a No. 9 taper hole. It can be locked for grinding on dead centers. The phosphor bronze boxes with means of compensation for wear are protected by metal covers.

The footstock also slides on ways and can be clamped at two points. A holder for a carbon point is attached to it and the wheel can be conveniently trued without removing the work from the centers.

A tank cast in the bed of the machine holds an abundant supply of water. The pump is simple in construction and needs no priming or packing.

The equipment included with the machine consists of a No. 34 internal grinding fixture, an 8-in. four-jawed independent chuck, "face plate," face chuck, two universal back rests, four adjustable bronze shoes, a center rest, two grinding wheels, one offset 12 in. in diameter, and one offset 14 in. in diameter, a set of dogs, a set of telescopic water guards and a full complement of wrenches. Overhead works are also included, consisting of one pair of tight and loose pulleys, 18 in. in diameter, for a 5 in. belt, and a speed of 425 r.p.m.

The machine weighs 6,950 lb. and requires floor space of 42⅝ in. at right angles to the wheel spindle and 142 in. parallel with the spindle. It can hold work 14 in. in diameter by 36 in. in length and swings 12½ in. over the water guards.

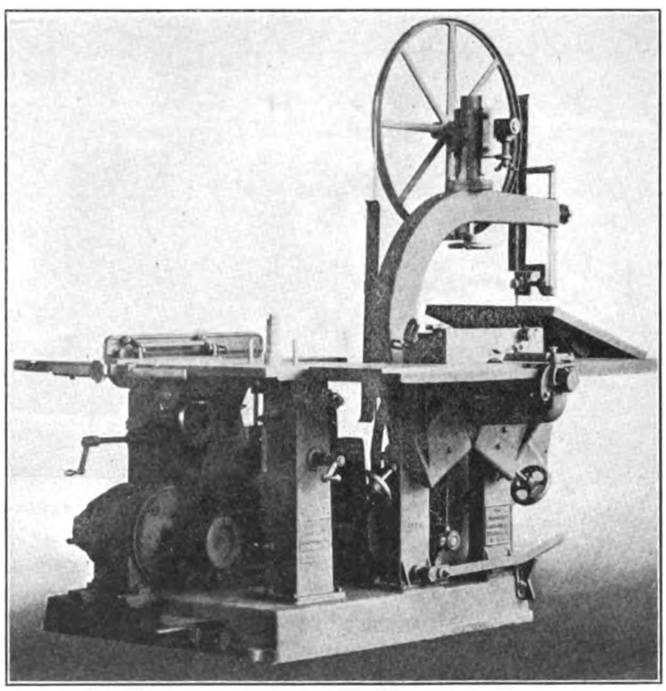
A Wood Worker With Five Separate Tools

The Crescent Machine Company, Leetonia, Ohio, has re-designed its universal wood working machine. The saw table is now entirely separate from the shaper and the borer is also placed so as to be operated independently. The saw table can be raised and lowered to allow for cutting through various thicknesses of material, and may be tilted to an angle of 45 deg. by means of a hand wheel and worm gear tilting device. A scale and pointer are provided to indicate the degree of angle. These features make the machine as convenient for all practical purposes as independent machines, because it is possible to do five different kinds of work on the machine at one time.

The machine consists of five separate units, a band saw, a jointer, a saw table with tilting top, a shaper and a borer. It is provided with an individual means for starting and stopping each unit independently, so that all five machines can be used at one time. Each of five operators may have complete control of his machine and is free from any interference by any one of the other operators.

Endless leather belts are furnished with the machine for driving each separate unit. The belts are so located within the machine that they are entirely out of the way. The starting and stopping of each part of the machine, with the exception of the shaper, is accomplished by means of a belt-tightening pulley operated by a lever. The tightening pulleys are adjustable, so that the belts may always be used under the proper tension. The belts do not run unless the machines are in operation. The shaper is started, stopped or reversed by means of friction cones controlled by a foot operated lever which may be securely locked in any position. All sliding adjustments are gibbed for the purpose of taking up the wear.

The base is a single cored-out casting, reinforced with heavy ribs. It sets flat on the floor, thus giving substantial support. The several units that compose the machine are mounted on cast iron, cored-out, hollow pedestals that are bolted to the base on machined surfaces. This method of consolidating the pedestals with the base gives to the machine the rigidity and sturdiness of hollow construction, without being cumbersome in appearance, and insures a steady running machine that is practically free from vibration.

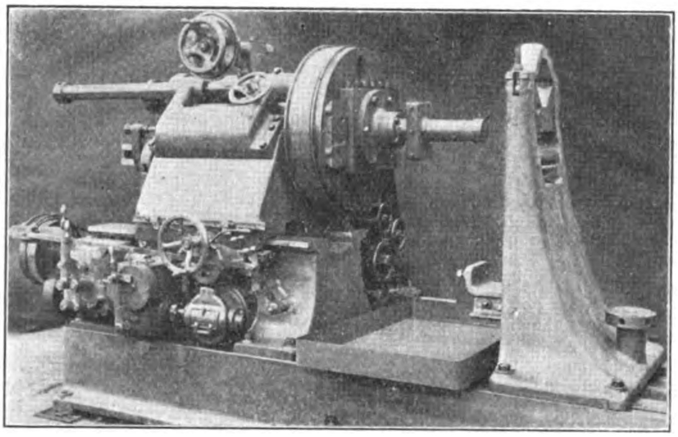


This Machine Is Equipped with a Band Saw, Jointer, Circular Saw, Shaper and Borer

One of the new features of the machine is that no special motor base is required. The regular base is so designed that any standard motor may be easily attached.

Crank Pin Grinding and Quartering Machine

A LOCOMOTIVE crank pin grinding and quartering machine of the double headed type has recently been developed by the Churchill Machine Tool Company, Ltd., Manchester, England. The machine is designed specifically to deal with right hand lead crank pins. It consists of a main base plate which carries two supports for the axle and two grinding heads, located one at each end of the base plate. These heads are operated from the same side of the machine and provision has been made for either an electric motor or overhead countershaft drive, arranged independently for each head. They are carried on slides machined at 90 deg. and are adjustable on the angular slides by means of fixed dead stops, so that the machine can grind crank pins of an effective throw from 11 in. to 15 in. The fixed dead stops are arranged in .1-in. steps to cover the above range.



The Single End Machine

The driving mechanism of the grinding heads is mounted on a base bolted securely to the base plate. The heads have an automatic traverse of 24 in. on the slides. This length of travel is suitable for the grinding of pins up to 15 in. and also the grinding of parallel crank pin holes through the driving wheel. The main spindles are 6 in. in diameter at the main bearing. The cross adjustment mechanism of the grinding snout for the planetary motion is of rigid construction and provides an accurate and positive feed. A ball thrust is provided at the main spindle to facilitate ease of operation when drilling or boring. The grinding snouts are detachable and various sizes may be used.

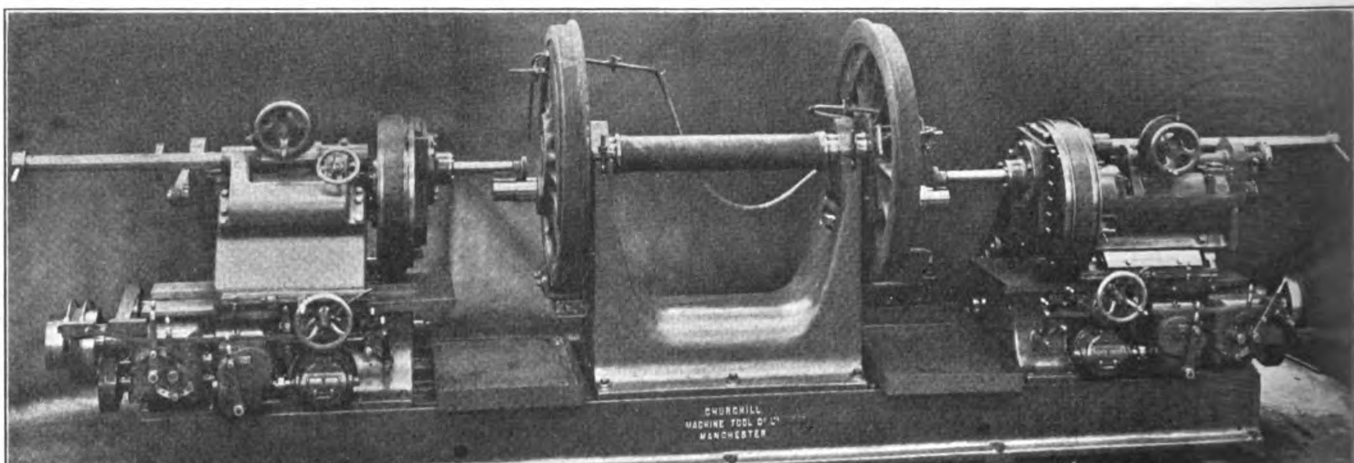
In addition to the traversing motion for the purpose of moving the grinding wheel along the pin, the machine is also provided with a range of boring feeds so that the machine may be fitted with tools for the purpose of drilling and boring holes in a new driving wheel; or in case there is more metal to be removed than would be advisable by the grinding process, it may be fitted with cutting tools for the purpose of turning the pin.

The slide that carries the grinding or boring snouts is arranged so that it can be brought to a position which coincides exactly with the center of the main spindle. A dead stop is provided for this purpose. The tool slide is also provided with a special quick adjustment to the center position. The total amount of this cross adjustment from maximum to zero is 5½ in.

The traverse feeds of the grinding heads, as well as the rotary motion of the main spindle, are obtained from a self-contained gear box, which is provided with three boring feeds, three grinding head traverse speeds, and three spindle speeds. All the control levers are arranged in a convenient location for the operator.

The axle is supported on the journal bearing, as shown in the illustration. The V-blocks are adjustable vertically in the axle supports. The axle can be accurately located for the center height by means of a centering bar carried on each grinding head. Provision is also made for fine adjustment when grinding crank pins and for locking the driving wheel after its proper position has once been determined.

This machine is also built with a single end, the construction of which is in all respects similar to the double-ended machine, with the exception that the left-hand head is not used. A tail stock is fitted to the machine instead, which is provided with centering bars to locate the centers of the axle and crank pin. The approximate net weight of the machine complete is 12½ tons.



This Machine Is Designed Specifically to Handle Right Hand Lead Crank Pins

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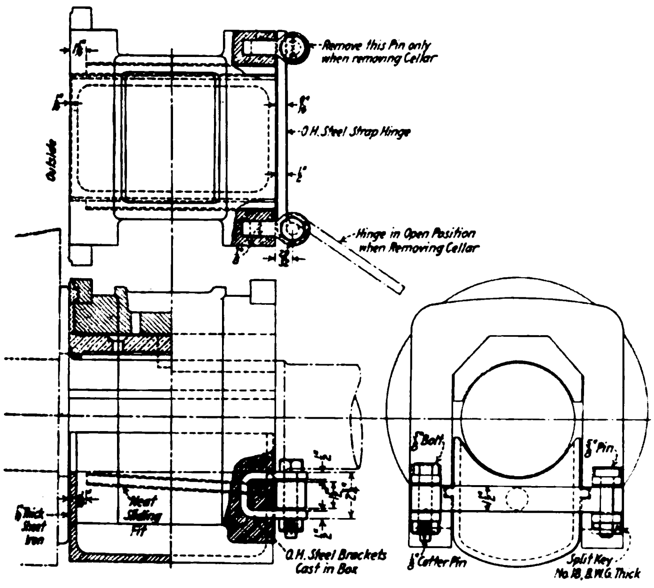
In Order to help the attendant of a punching machine to locate the work under the tool properly, a neat dodge has been adopted by the Pressed Steel Car Company. A small hole is drilled up the center of the punch, and an electric light is arranged in the punchholder above. A spot of light is projected on to the plate, which is manoeuvred until the spot coincides with the centre punch dot of the marker-out.

An Attachment for Holding Journal Box Cellars

An improved journal box attachment and lubrication cellar is shown in the drawing. This device is adaptable to various types of engines and trailer truck boxes, as well as driving boxes. The drawing shows how it is applied to an engine truck box. The cellar is supported by two slides on the inside of the box, one on each pedestal leg, which extend from the front to 1 1/16 in. to the rear. These slides may be cast in the form of a groove when the box is made, as show in the drawing, or they may be made by welding bent wrought steel plates to the sides so that the projecting leg will carry the cellar. The retaining attachment is made from a piece of 1⅝-in. by ½-in. steel. It operates like a hinge and has one end bent to take the hinge pin. The other end is secured by a pin which fits into a bracket on the opposite side of the box and is prevented from falling out by a split key.



Attachment for Preventing the Loss of Lubrication Cellars

The cellar recommended by the inventors is made from a piece of 1/16-in. sheet brass and has tapered side extensions to engage with the grooves in the box. The drawing shows a cast-iron cellar, but various kinds of cellars may be used to suit the railroad company's standard practice.

This device, known as the E-C journal box attachment and on which patents are pending, was designed by F. H. Einwaechter and F. A. Cardegna, Baltimore, Md. The purpose of the improved fastening is to prevent loss of the cellar. The sheet steel cellar recommended by the inventors is considerably cheaper to make and insures a longer life than the cast steel, cast iron or malleable cellars generally used. The reduction in weight and the easy manner in which the cellars are removed from the box are said to effect a considerable saving of time at terminals in packing and handling.

Cylinder Cock Designed to Operate Automatically

A cylinder cock, designed to provide a valve that will drain automatically, has recently been invented (patented) by A. Abbamonte, Cheyenne, Wyo. The device is operated in the following manner: When the main steam throttle is open, the steam pressure closes the valve 7, causing it to rest on the seat *A*. This movement opens the piston 4. When the throttle is closed, the steam pressure is lower than the tension of the spring 2, and this spring closes the piston valve on the seat *B*, thus protecting the operating portion of the cylinder cock from becoming stuck with deposits from the oil. Valve 7 is opened by this return movement and allows all the fluid, that may have accumulated, to escape to the atmosphere through the outlet *C*.

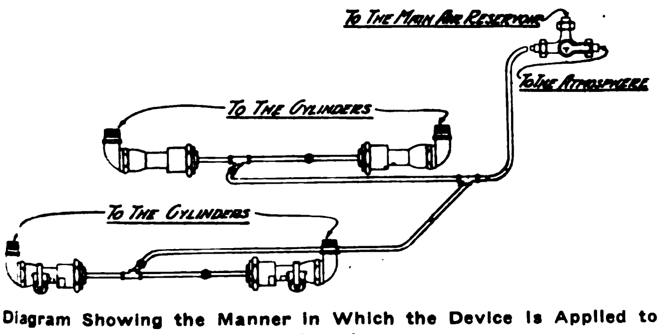
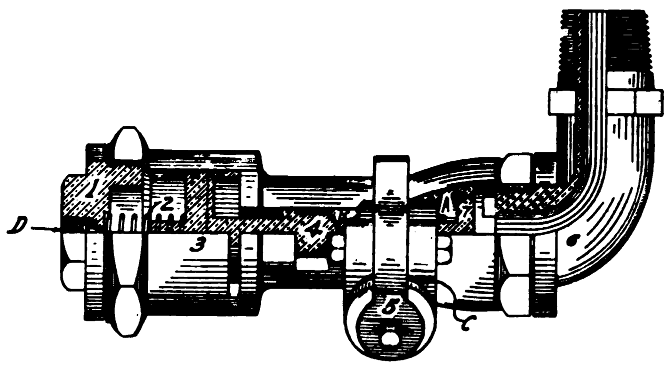


Diagram Showing the Manner in Which the Device Is Applied to the Cylinders

When the engine is drifting with the throttle closed, a vacuum is formed in the steam pipes, steam chests and cylinders, which closes the check valve 5 on the seat of outlet *C*, thus preventing cold air and dirt from entering the cylinders.

When the engineman wants to open the cylinder cocks while the engine is working under full steam pressure, he opens the three-way cock connected to the opening *D* with the main air reservoir. When the three-way cock is opened, the main reservoir is connected on the top of the piston 4, thus closing this piston on the seat *B*, and opening valve 7. This allows the steam to blow from the outlet *C*. When the three-way cock is closed, the opening *D* is exposed to the atmosphere and the steam pressure on the top of valve 7 causes it to reseat itself and to open the piston 4.

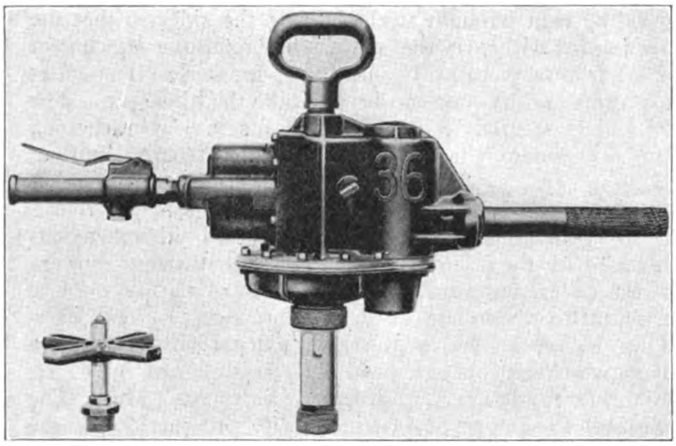


Drawing Showing the Working Parts of the Abby Automatic Cylinder Cock

It is essential that the cylinder cock be placed in a horizontal position, with the check valve 5 when at rest in a perpendicular position and ¼ in. from the outlet *C*. This position will make a 55-deg. steam blow from the outlet *C*. About 20 lb. steam pressure is needed to close the valve 7 on its seat and when the pressure is lowered 5 lb. valve 7 will open automatically. When the engineman opens the cylinder cock by air pressure, the piston 4 closes on the seat *E* and stops all air leaks passing through piston ring.

A Special Air Drill for Reaming Service

THE extent to which portable drills are used in reaming operations in railroad shops, and the special demand of this work arising particularly from the wide fluctuations in load in reaming different thicknesses of materials, has led to the recent development of a portable air drill which is designed specially for this work. This drill is the No. 36 Red Giant drill of the Chicago Pneumatic Tool Company, New York. While the design of this drill is not revolutionary it is distinctive in a number of particulars. The main objectives sought in its development are said to be capacity for uninterrupted service, ease of operation and reduced maintenance.



The Red Giant Portable Drill Used for Reaming

The new drill weighs 35 lb. and is unusually well balanced, affording easy control and enabling it to be handled by one man for down or side hole reaming. The spindle is of the extension type with a slot for the convenient ejection of the reamer or drill. One of the most prominent features of the drill is the power, which is usually large for drills of this weight. This makes the machine especially adaptable where the work varies from single plates to multiple plates and gussets with forgings, gray iron and steel castings interspersed between them, and where the quantity of metal to be removed produces a constantly changing power factor. All of the working parts are made extra large to provide an ample safety factor. As the motor is double acting and is provided with a packing gland or stuffing box, there is no leakage of air into the crank case. The lubrication is of the flash type and as there is no air to bleed through from the crank chamber there is no loss of lubricant as a result of its being carried out into the escaping air. The crank shaft and bearings differ slightly from those of the standard Little Giant designs, having the eccentric located between the throws and an integral part of the forgings. This crank shaft is mounted on three ball bearings, the extra or third ball bearing insuring proper shaft support on both sides of the main drive gear and contributing to an unusually low frictional resistance in the machine.

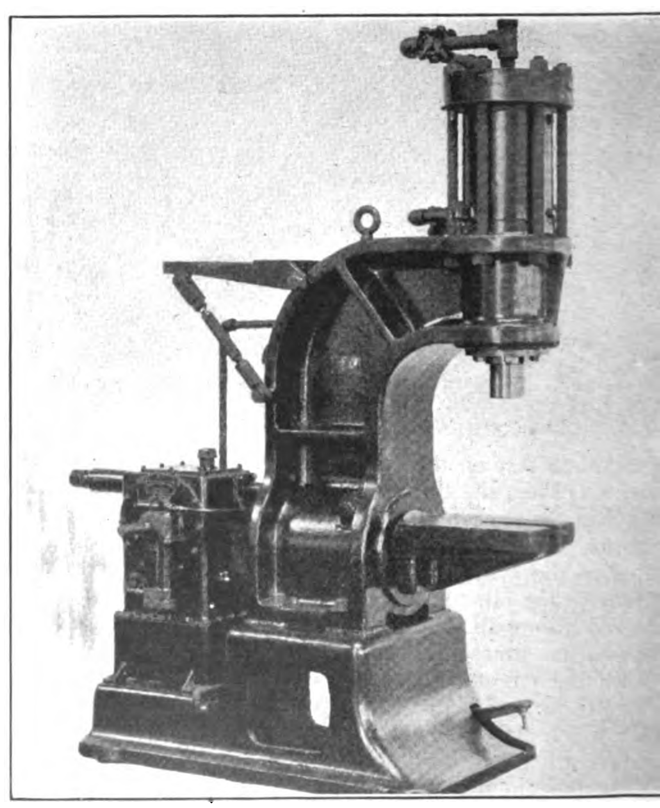
A Self-Contained Hydraulic Riveter

A SELF-CONTAINED riveter of the hydraulic type has recently been developed by the Oilgear Company, Milwaukee, Wis. The machine may be located anywhere on the shop floor where it can be driven from any constant-speed source of power. A constant-pressure pump furnishes oil to the cylinder free from pulsations. The delivery may be changed instantly to any desired pressure from zero to the maximum capacity of the machine and the displacement is positive against any resistance up to the capacity of the machine. Thus there is no delay in waiting for the pressure to build up as it is available the instant resistance is met.

As shown in the illustration, the frame is of ribbed construction and is securely bolted to the bed. The shape of the bed is such that it permits the location of the pump in rear of the frame. This arrangement makes the machine a self-contained unit and also tends to simplify its installation in the shop.

Another feature is that the horns being of the removable type, makes the machine adaptable to the various kinds of work around a railroad shop. All the parts are easily accessible. Special attention was given in the design of the machine to the cost of maintenance, which is an important factor to be considered.

Foot-treadle control is provided which allows the operator the use of both hands for the work. The speed of the machine is limited only by the adeptness of the operator in placing the rivets. The stroke is 4 in. and the design allows for placing the work so that the strokes can be limited to clear the work on the up stroke or on the return to ram position. The horn shown in the illustration is of special design to accommodate an indexing fixture, but removable horns of any design may be used. This riveter is manufactured in two standard sizes of 10 and 20 tons' capacity, respectively. Both of these sizes may be driven from any constant speed source of power, which makes it adaptable to varicus operating conditions and requirements.

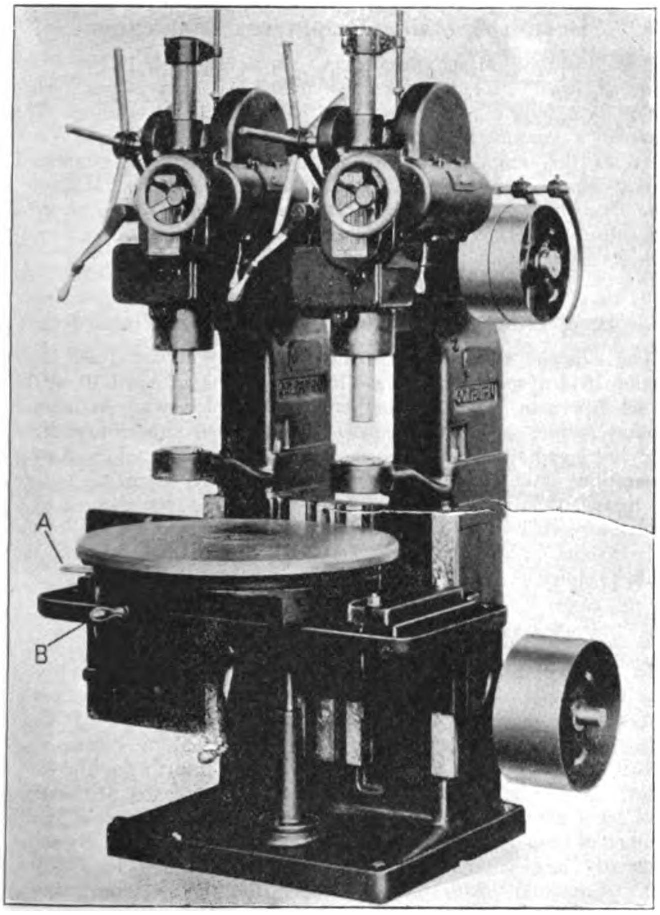


The Speed of This Machine Is Limited Only by the Adeptness of the Operator.

Two-Spindle Drill Press

THE Colburn Machine Tool Works of Cleveland, Ohio, has developed a two-spindle drill press, known as its No. 2 heavy duty. As shown in the illustration, the machine is similar to the regular No. 2 type, except that it is equipped with steady supports and has a special three-station rotating table.

Two No. 2 heads are mounted on a common column, which carries a bracket type table extending the full length of the



Drill Press Equipped with a Special Three-Station Rotating Table

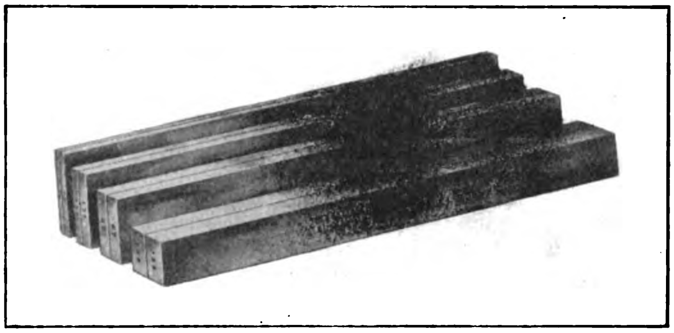
machine. To this table is clamped a rotating table, which is provided with three stations; loading, drilling and reaming. Steady supports are provided for supporting the bar. The indexing latch is released by the lever *A*. The lever *B* is used to clamp the table in position after it has been indexed. An automatic trip, together with spring type counterweights, returns the spindle automatically to the starting position after each operation.

The machine is driven by a five-horsepower motor mounted on a bracket at the rear, and is geared to the jack shaft. Each head is driven by a belt operated from this shaft. The heads are entirely independent of each other and can be operated at different feeds and speeds.

The machine is designed for the purpose of machining duplicate parts in quantities and for handling work requiring a wide range of speeds and feeds. A patented transposing gear arrangement permits flexibility and provides a means for securing the correct speeds and feeds for the work to be performed. On some work where two stations for drilling are wanted, a four-station rotating table can be used instead of the three-station type. The table would then be indexed 180 deg. in order to bring the work under the spindles.

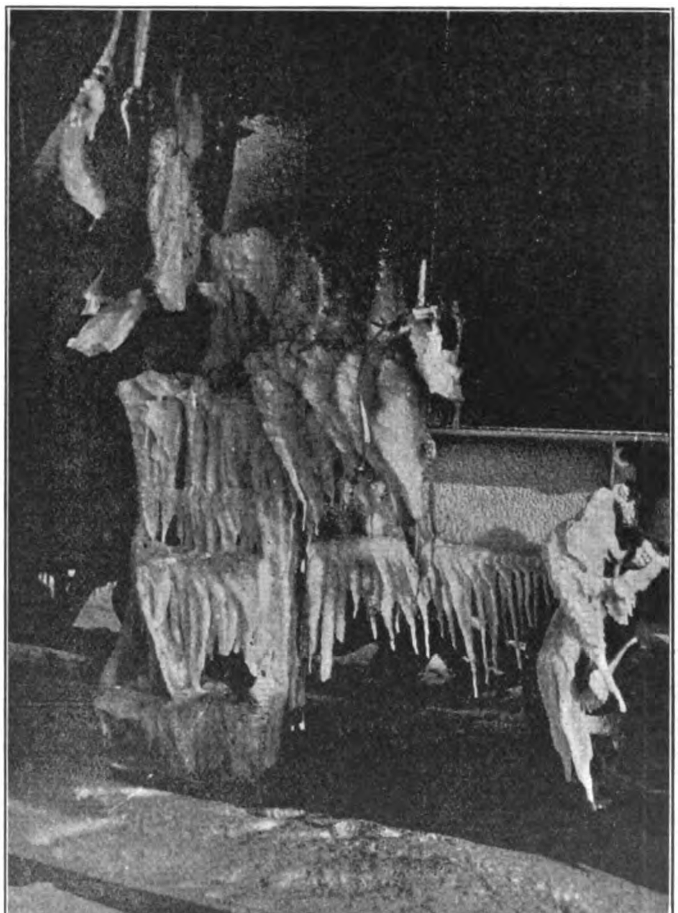
Steel Parallels of Practical Dimensions

THE L. S. Starrett Company, Athol, Mass., has made a recent addition to its line of precision tools in the shape of two sets of parallels made from a special grade of tool



Handy Precision Tools for Mechanic, Toolroom or Machine Shop

steel, hardened and ground. These sets consist of eight pairs of parallels which may be purchased in individual pairs or combinations of pairs by the mechanic, or complete for the tool room or machine shop. The dimensions to which they are made are those which experience has shown to make the most practical combinations. They are all 6 in. in length.



Ice from Stoker Engine Drip Pipe Discharging Near Top of Tender Steps Caused This Condition

GENERAL NEWS

The boiler shop and three other buildings of the Missouri Pacific shops at Ft. Scott, Kans., were destroyed by fire on April 16; estimated loss $30,000.

The Interstate Commerce Commission has reopened its investigation into the question of the construction and repair of cars and locomotives for further proceedings relating to the equipment of the Central of New Jersey.

The Anatolian Railway of Turkey plans to spend over $3,500,000 during the current year for the purchase of 30 locomotives, a number of passenger cars and a new station at Haidir-Pasha, according to Commerce Reports.

The Interstate Commerce Commission's report to Congress for March on the condition of railway equipment shows that during the month 5,683 locomotives were inspected; that 2,674 were found defective and 468 were ordered out of service. Also 99,234 freight cars were inspected, of which 4,461 were found defective; and 1,814 passenger cars, of which 41 were found defective.

In February this year the following railway car supplies were imported into Canada from the United States: 21 box and flat cars, valued at $27,857; 3 tank cars, valued at $1,311; 168 other cars, valued at $6,826; parts of railway cars, valued at $136,169; 3 motor cars for railway use, valued at $607. This is a report compiled by the Dominion Bureau of Statistics.

The Union Pacific has organized a standardization committee which is visiting every shop on the system investigating methods and apparatus with a view to increasing efficiency. The committee consists of J. W. Highleyman, assistant superintendent of motive power and machinery, J. J. Kelker, superintendent of shops at Pocatello, Idaho, W. R. Ladd, superintendent of shops at Portland, Ore., and A. S. Norris, master mechanic at Los Angeles, Cal.

Tank Car Specifications

The effective date of the requirements of Section 7 (c) of the specifications for Class I and II tank cars, and the last paragraph of Section 7 (d) of the specifications for Class III and IV tank cars has been extended to December 1, 1924. These sections of the tank car specifications of the American Railway Association provide that no nipples, valves or other attachments shall project below the bottom outlet cap, except while car is being unloaded.

Labor Board Decisions

Representation of Individual Shop Crafts Employees.—The Labor Board decides that the railway employees' department of the American Federation of Labor has the right to represent individual employees on the Great Northern who have grievances under the provisions of the existing agreements. The dispute in this case involved a memorandum of settlement with certain striking shopmen in the latter part of 1922 and its alleged violation in the case of one employee by the railway management.—*Decision No. 2304.*

Boston & Maine Employees' Magazine

The Boston & Maine Employees' Magazine, Vol. 1, No. 1, the issue of April, 1924, has been distributed. It is a 24-page publication, 6 in. by 9 in., illustrated, and it carries no advertising. The company's announcement reads in part:

"With this number the Boston & Maine Bulletin, established a year ago, becomes the Boston & Maine Employees' Magazine. The change is not a new departure but a growth. We have no pretentious plans. But there is need of better means of information about the public service in which we are engaged. . . . ."

B. & O. Fuel Conservation Moving Picture

The Chicago chapter of the International Railway Fuel Association held a special meeting Thursday evening, April 10, at the Hotel Sherman, Chicago, the feature of which was an unusual motion picture presented by W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore & Ohio. Among other things, the chemistry of combustion is shown in this picture by means of animated characters, carbon being represented by a negro, oxygen by a police officer and hydrogen by a girl called the "Hydro-girl." This was the first showing of the film off the B. & O. lines.

Wage Statistics for January

In January, 1924, the number of employees of Class I railroads was the lowest recorded since September, 1922, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The number reported was 1,749,927, a decrease of 29,589, or 1.7 per cent as compared with the returns for the same month last year. The total compensation decreased $10,501,535, or 4.2 per cent. The difference in the percentage decrease in the number of employees and their compensation was due chiefly to an unusually large number of overtime hours worked in January, 1923. Compared with the preceding month, the reports for January, 1924, show a decrease in employment of 2.4 per cent. The total compensation, however, shows an increase of 2.1 per cent due principally to the fact that the number of working days was greater.

Standardization of Freight Cars in England

A plan for standardization of railway freight cars has been arranged between the railway clearing house for the companies and the private car owners, by which all freight cars built in future will be of two standard specifications only—12-ton and 20-ton. This change, contemplated for years, may be attributed largely to the unification of railways under the act of 1921. Great savings are anticipated eventually from this plan, not only in

LOCOMOTIVE REPAIR SITUATION—FORMER METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. held for repairs req. over 24 hours	Per cent	No. held for repairs req. less 24 hours	Per cent	Total held for repairs	Per cent
January 1	64,453	48,905	576	13,587	21.1	1,962	3.0	15,549	24.1
April 1	64,559	50,107	914	12,801	19.8	1,651	2.6	14,452	22.4
July 1	63,906	52,456	2,181	10,326	16.2	1,124	1.8	11,450	18.0
October 1	63,982	54,159	2,620	8,789	13.7	1,034	1.6	9,823	15.3
1924									
January 1	64,406	54,031	5,061	9,395	14.6	980	1.5	10,375	16.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9

acilitating repair and in aiding train assembly, but also in cheapen-ng first cost and in promoting mass production.

Quantity output schemes are already being introduced at car-uilding plants. At Cardiff, an extension of the Crown Wagon & Engineering Works is under way to expedite the specialized con-truction of steel-frame box cars and the construction of the new 0-ton coal cars. The Great Western Railway serving that terri-ory is urging colliery owners to adopt the 20-ton size, and offers 5 per cent freight rebate on coal traffic so carried.

Canadian Shopmen Favor B. & O. Plan of Co-operation

The convention of the Canadian section of Division 4, Railway Employees Department, of the American Federation of Labor, meeting in Montreal, representing 35,000 rail shopmen on Canadian lines, has gone on record as favoring the Baltimore & Ohio plan of co-operating with the management and expressed the desire to see the plan adopted in Canada. Following the endorsement by the convention, the matter will be taken up by the Canadian Pacific System Federation and the Canadian National System Federation at their conventions which open simultaneously in Montreal immediately upon the conclusion of the Division 4 convention. The next step would be the making of a survey of the line to designate some one point at which the plan could be tried out. Managements of the railways would then be approached. A vote of the men throughout the system would be necessary before the plan could be put into effect.

Locomotive Shipments in March

The Department of Commerce has prepared the following table of shipments of locomotives in March. This report covers the principal manufacturing plants and is based on reports received from the individual establishments. The table gives the shipments of locomotives in March and unfilled orders as of March 31, with comparisons for earlier months.

	LOCOMOTIVES					
	Shipments			Unfilled orders		
Year and month	Total	Domestic	Foreign	Total	Domestic	Foreign
1923						
January	229	217	12	1,788	1,699	89
February	207	196	11	2,220	2,141	79
March	282	269	13	2,316	2,214	102
April	217	201	16	2,204	2,111	93
May	238	228	10	2,150	2,045	105
June	232	221	11	1,958	1,854	104
July	239	211	28	1,738	1,652	86
August	272	259	13	1,497	1,406	91
September	335	313	22	1,178	1,102	76
October	310	295	15	977	915	62
November	299	270	29	691	656	35
December	329	305	24	387	365	22
1924						
January	151	147	4	376	344	32
February	99	92	7	499	466	33
March	132	128	4	534	494	40

Labor News

The Nashville, Chattanooga & St. Louis has granted increases of one cent an hour to employees in the mechanical department; mechanics, carmen, helpers, apprentices and laborers.

To enable their union to become "more militant" railway shopmen of the Canadian Pacific Railway last week devised ways and means of increasing the revenue of their organization by 100 per cent. The decision was made by forty delegates who attended a convention of the company's Federation of Employees. Their action is regarded in Montreal as significant, in view of the approval last week of a draft wage scale which would raise the wages of shopmen to the 1920 level.

Announcement was made in Boston on April 4 that the strike of shopmen on the Boston & Maine, which was begun on July 1 1922, had been called off.

The Federated Shop Crafts on the Baltimore & Ohio have made a request for a general increase of pay sufficient to restore the rates which were in force on July 1, 1921.

The strike of the shop crafts employees on the Chicago, Rock Island & Pacific, which began on July 1, 1922, has been officially terminated by the Railway Employees' Department of the American Federation of Labor, in accordance with a plan upon which the Rock Island offered to reemploy the strikers. Former employees who desire to return to work are to register at points where they formerly worked within the next 60 days. Those who register will be given preference for employment over other new men during the 60-day period of registration and for six months thereafter. Employees who register will be provided with work as soon as opportunity offers, but present employees will not be displaced. The rights and seniority of the men now in service will not be interfered with or affected by the employment of any former shop employees. In the reemployment of former employees who register the relative seniority rights as among themselves will prevail, in accordance with the seniority roster before the strike began. This does not mean that former employees will secure their old seniority, but that their seniority as new men will be arranged according to their seniority before the strike. The Rock Island has refused to enter into any contract with the federated shop crafts and will continue to negotiate with its shopmen through the present "company" organization.

MEETINGS AND CONVENTIONS

The Association of Railway Electrical Engineers will hold its semi-annual meeting on Thursday, June 12, at the Hotel Dennis, Atlantic City, N. J.

Fuel Association Convention

The International Railway Fuel Association will hold its convention at the Hotel Sherman, Chicago, on May 26-29. R. H. Aishton, president of the American Railway Association, and Charles Donnelly, president of the Northern Pacific, will address the meeting. The subjects to be discussed will include oil and coal as locomotive fuel; the budget system; fuel losses at locomotive terminals; the mining, preparation and inspection of coal for locomotive fuel; main tracking and its effect on fuel, and the analysis of the report of the United States Coal Commission.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 6 to 9.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILROAD ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York. Spring meeting.

FREIGHT CARS, INSTALLED AND RETIRED

Month	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
December, 1923	18,690	881,168	14,411	548,950	2,307,997	100,527,725	1,515
Full year, 1923	183,367	....	185,508	....	....	....	....
January, 1924	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February, 1924	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March, 1924	9,923	....	....	....	....	....	....
Total for 2 months	26,975	....	22,795	....	....	....	....

Figures as to installations and retirements prepared by Car Service Division A.R.A. published in Form CS 15-A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment. Total of cars retired will include in addition to such rebuilt cars, equipment sold to other than railroad companies such as Sandy Valley & Elkhorn equipment turned over to Consolidation Coal Company as a result of sale of S. V. & E. by Baltimore & Ohio to the coal company. Figures reported by the Car Service Division include cars owned by railroad controlled private car lines,—American Refrigerator Transit, Fruit Growers Express, Pacific Fruit Express, Merchants Dispatch Transportation Company and Western Fruit Express. The railroads turned over a large number of cars to these respective companies during 1923. Such equipment is shown as retired by the railroads and installed by the car lines. Figures for the car lines mentioned show that during 1923 they installed 14,508 cars including new and cars of former railroad companies. The car lines retired 293 cars and on January 1, 1924, had 1,240 cars on order.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 23-27, Chalfonte-Haddon Hall, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Semi-annual meeting June 12, Hotel Dennis, Atlantic City, N. J.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que., Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 16, 17 and 18.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting May 13. The speaker will be E. S. Jouett, vice-president, Louisville & Nashville.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23. Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting May 13. Annual banquet and entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Tuesday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting May 9. A paper on the Consolidation of Railroads, or some kindred matter will be read by W. A. Colston, vice-president and general counsel, N. Y., C. & St. L., Cleveland, Ohio.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 9-14, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August. Annual meeting May 23, at Edgewater Beach Hotel, Chicago. Fred W. Sargent, vice president of the Chicago & North Western, will be the speaker.

Burlington Route GOOD Burlington Route

CYLINDER VALVE PACKING ARE TRUE FRIENDS OF THE ENGINEER AND FIREMAN

Example of 28-in. by 22-in. Placards to be Posted Monthly in Enginehouses and Enginemen's Washrooms by the Chicago, Burlington & Quincy for the Purpose of Causing Discussion and Creating Interest in Fuel Economy.

SUPPLY TRADE NOTES

The T. H. Symington Company has moved its Chicago offices to 2108 Straus building.

The American Steel Foundries has moved its Chicago offices to 410 North Michigan avenue.

John H. Lord, of Joseph T. Ryerson & Son, Inc., Chicago, died on March 30 at Louisville, Ky.

The Griffin Wheel Company has removed its Chicago office from 332 South Michigan avenue to 410 North Michigan avenue.

Charles N. Winter, managing editor of the Locomotive Cyclopedia and the Car Builders' Cyclopedia, has resigned to become general manager of the Rogatchoff Company of Baltimore, Maryland. Mr. Winter began his engineering career in 1904 in Poughkeepsie, N. Y. In 1906 he entered the engineering department of the American Brake Shoe & Foundry Company, serving as draftsman and as engineering inspector of new work. He resigned this position to enter the engineering department of the American Car & Foundry Company at New York, in 1913 returning to the American Brake Shoe & Foundry Company as chief draftsman. In 1915 he removed to Virginia where he served in the test department of the Norfolk & Western at Roanoke, and in the office of the engineer at the Richmond Works of the American Locomotive Company. In 1918, Mr. Winter accepted a position on the editorial staff of the Simmons-Boardman Publishing Company and compiled the 1919 edition of the Car Builders' Cyclopedia. At the close of this work he became associate editor of the Railway Age and the *Railway Mechanical Engineer*. In 1921 he became managing editor of both the Locomotive Cyclopedia and the Car Builders' Cyclopedia, resigning from this latter position to take up his new duties which will include the direction of sales and advertising for the Rogatchoff Company in the United States and Canada, and also in Great Britain and Australia. The sales offices will be located at 90 West Broadway, New York City, and in the Koehler Building, Ridgewood, N. J.

C. N. Winter

The American Car & Foundry Company has acquired the plants of the Pacific Car & Foundry Company at Portland, Ore., and Seattle, Wash.

The Union Tank Car Company, New York, will, on May 15, establish an office in the McCormick Building, 332 South Michigan avenue, Chicago.

H. S. Patterson, manager of the railroad department of the Walworth Manufacturing Company, Boston, Mass., died on April 6 at Norfolk, Mass.

M. A. Downs and W. G. Guy have been appointed service engineers in the railroad department of the Paige & Jones Chemical Co., New York City.

The Sellers Manufacturing Company, Chicago, has moved its general sales offices from 1204 McCormick building to 1927 Illinois Merchants Bank building.

The Zapon Leather Cloth Company has moved its New York offices from 200 Fifth avenue to the Park-Lexington building, Park avenue and Forty-sixth street.

The Westinghouse Air Brake Company has removed its New York office from the Benenson building, 165 Broadway, to the new

Westinghouse building, which has just been completed at 150 Broadway.

The Lone Star Tank Car Company, Wichita Falls, Tex., is contemplating the construction of a plant for the repairing of tank, steel and gondola cars at Fort Worth, Tex.

James A. Long has been appointed general manager of the Woodward Iron Company, Woodward, Ala., succeeding A. J. Boynton, who is now associated with H. A. Brassert, Inc., Chicago.

Edwin W. Allen, assistant district manager and district engineer of the General Electric Company, with headquarters at Chicago, has been promoted to manager of engineering, with headquarters at Schenectady, N. Y.

The Youngstown Steel Car Company, Niles, Ohio, has opened a new district office in the Canadian Pacific building, New York City. This office is in charge of John H. McCartney, formerly representative at New York for the Standard Tank Car Company.

C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, has been appointed president of the M. E. White Company, the White Construction Company and other affiliated companies, with headquarters at Chicago.

The North Judson Car & Equipment Company, North Judson, Ind., has been organized for the purpose of rebuilding and repairing railroad freight cars. It also intends to go into the building of new equipment in the near future. The company has a tract of 70 acres at North Judson, Ind., on which it is now erecting buildings. A. M. Oliver is president and general manager, C. E. Reese is vice-president, A. Lincoln Long is secretary and treasurer and J. G. Capouch is general counsellor.

Death of Dr. Wilhelm Schmidt, Famed for Work with Locomotive Superheater

Dr. Wilhelm Schmidt, whose pioneer work relating to the art of steam superheating led to the development of the most widely used types of locomotive superheaters, died on February 16 at Bethel, near Bielefeldt, Germany, at the age of 66. Dr. Schmidt started his career as a locksmith and through coincidences his natural ability to speculate correctly on matters of physics and engineering came to the attention of prominent men who made it possible for him to educate himself and carry through the realization of his ideas. Schmidt, who in early years recognized the great importance of the superheating of steam for the economy of steam engines, spent the larger part of his life in fighting the prejudices that made learned engineers opposed to this practice and to build up an organization which was finally able to overcome these prejudices and carry his ideas to commercial success. His best known accomplishment was the creation of a practical locomotive superheater, but he also did much towards the practical superheating of steamships and stationary power plants. In the last ten years of his life he spent much effort and vast sums of money on the demonstration of practical ways and means to combine the thermal advantages of high superheat with the thermal advantages of relatively high steam pressures, which he termed "super-pressures." While he did not live to see his inventions relating to steam super-pressures widely exploited, he had the satisfaction of having the engineering fraternity of his own country acknowledge the genius of his conceptions in this field, also. As a man entirely self-educated, he had many unusual honors conferred upon him, and one of the universities of his country conferred upon him an honorary degree of Doctor of Engineering.

Dr. W. Schmidt

TRADE PUBLICATIONS

Graphic Instruments.—Bulletin No. 324, a four-page folder touching upon the use of graphic instruments in small plants, the use of graphic records to effect various plant economies, has been issued by the Esterline-Angus Company, Indianapolis, Ind.

Oilgear Products.—Four bulletins, Nos. 30, 31, 32 and 33, descriptive of broaching and assembling presses, the Type W variable delivery pump, the Oilgear hydraulic riveter and the Oilgear bench press, have been issued by the Oilgear Company, Milwaukee, Wis.

Fuel Line Tubing.—A 20-page brochure, containing a complete report of tests made by the Underwriters' Laboratories in Chicago and describing the entire process in the manufacture of Bundy tubing, has been issued by the Bundy Tubing Company, Detroit, Mich.

Lathes.—A brief outline of the construction details of LeBlond machine tools and a few of their applications to railroad work are contained in a 46-page illustrated book recently issued by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. The book is entitled "LeBlond Lathes in Railway Maintenance Service."

Bent-Tube Boilers.—The Heine Boiler Company, St. Louis, Mo., has issued an attractive 26-page bulletin, No. 54, descriptive of its V-type, bent-tube boiler, which consists of three upper steam and water drums and one lower water drum, interconnected by bent tubes acting as steam conductors or water circulators. Details of the construction of various installations are shown in cross-sectional views.

Material Handling Equipment.—Catalogue No. 21-M, recently issued by the Yale & Towne Manufacturing Company, Stamford, Conn., contains complete details of Yale chain blocks, trolleys and electric chain hoists, and shows tables of dimensions, weights, clearances, and lifting, lowering and running speeds. All essential information regarding each of these units for handling materials is also covered in the catalogue, which contains 100 neatly arranged pages.

Electric Furnaces.—Annealing of castings and wire, heat treating, calorizing, sherardizing and other processes using electric furnaces, are shown in Bulletin No. 48721 recently issued by the General Electric Company, Schenectady, N. Y. The publication is mostly pictorial in content, illustrating the application of direct heat electric furnaces in General Electric factories. Details as to heat, dimensions and function of each installation featured are given in descriptive captions.

Pressure Blower Sizes.—Bulletin No. 402, issued by the Johnston Manufacturing Company, Minneapolis, Minn., contains some interesting data and curves showing the general design and operating characteristics of the pressure blowers which this company makes for oil-burning furnaces and large coal forges. Of particular interest on page 3 of the bulletin is the description of a method of determining blower sizes for different installations. A table on page 4 is devoted to the dimensions and motor ratings for blowers of different capacities.

The Automatic Fire Door.—The present position in the field of locomotive operation of the automatic fire door, particularly as relates to the Shoemaker radial fire door, is clearly outlined in a four-page circular recently issued by the National Railway Devices Company, Chicago. The construction of the Shoemaker radial type door is clearly shown and red arrows pointing to various parts of the door emphasize its operating advantages. The fourth page of the circular is devoted to a diagram which shows the clearance lay-out of the Shoemaker radial fire door with a commonly applied mechanical stoker.

All Metal Car Connections.—A four-page catalogue No. 83 has been issued by the Barco Manufacturing Company, Chicago, devoted to steam heat connections between passenger cars, pointing out the benefits to be derived from making these connections metallic. Tests are quoted to show that the metallic joints tend to promote safety and in a specific case enable the regulating valve pressure to be increased 50 per cent or from 61 lb. to 93 lb. With this initial pressure 5 lb. of steam was obtained at the rear of a 10 car train in 6 min. 21 sec. Metallic steam heat and air connections in stations and yards are also shown in several illustrations.

PERSONAL MENTION

General

L. D. FREEMAN, assistant to the chief of motive power and equipment of the Seaboard Air Line with headquarters at Norfolk, Va., has resigned to become assistant to the chief mechanical officer of the Chesapeake & Ohio, with headquarters at Richmond, Va.

Master Mechanics and Road Foreman

T. J. CLAYTON has been appointed master mechanic of the Texarkana & Ft. Smith, with headquarters at Port Arthur, Tex., succeeding A. D. Williams, assigned to other duties. The headquarters of the master mechanic are changed from Texarkana, Tex., to Port Arthur.

J. DIETRICH, master mechanic of the Lincoln division of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Nebr., has been given extended jurisdiction to include the Omaha division, succeeding F. Newell, who has been assigned to other duties. The position of master mechanic at Omaha has been abolished.

GEORGE H. LANGTON, whose appointment as general master mechanic of the Chesapeake & Ohio was announced in the April issue of the *Railway Mechanical Engineer*, was born on April 13, 1872, at Hannibal, Mo. Mr. Langton received a grammar school education and served his apprenticeship on the Chicago, Burlington & Quincy. He was subsequently employed on various roads as a machinist, roundhouse foreman, general foreman and engineer, and successively served as master mechanic of the Sierra Railway of California; the Kansas City Southern and Texas Pacific roads. He then became superintendent of shops and master mechanic on the Seaboard Air Line, later holding similar positions on the Virginian. In March, 1923, he was appointed mechanical inspector of the Chesapeake & Ohio and in February of this year was promoted to general master mechanic, with headquarters at Clifton Forge, Va.

George H. Langton

Car Department

CHARLES T. REYNOLDS, general inspector of car maintenance of the Boston & Maine at North Station, Boston, Mass., has been transferred to Concord, N. H.

FRANK H. BECHERER has been appointed general inspector of car maintenance of the Boston & Maine, with headquarters at North Station, Boston, Mass., succeeding C. T. Reynolds, transferred.

Shop and Enginehouse

A. C. MELANSON has been appointed acting superintendent of the St. Malo shops of the Canadian National.

JOHN HAYES, roundhouse foreman of the St. Louis-San Francisco at Sapulpa, Okla., has been transferred to Afton, Okla.

J. V. STEVENS has been promoted to assistant roundhouse foreman of the Atchison, Topeka & Santa Fe at Clovis, N. M.

GEORGE C. STREET, drop pit foreman of the St. Louis-San Francisco at Sapulpa, Okla., has been appointed roundhouse foreman, succeeding John Hayes.

WALLACE W. BROWN has been appointed assistant superintendent of shops of the Boston & Maine, with headquarters at Billerica, Mass., succeeding G. A. Silva.

T. W. SEERY has been promoted to assistant night roundhouse foreman of the Atchison, Topeka & Santa Fe, at Clovis, N. M., succeeding F. J. Repman, transferred.

R. H. MALLETT, assistant roundhouse foreman of the Atchison, Topeka & Santa Fe at Clovis, N. M., has been promoted to roundhouse foreman, with headquarters at Belen, N. M.

HARRY L. LEIGHTON has been appointed superintendent of shops of the Boston & Maine with headquarters at Billerica, Mass., succeeding Thomas Jennings, assigned to other duties.

GEORGE A. SILVA has been appointed general inspector of locomotive maintenance of the Boston & Maine, with headquarters at North Station, Boston, Mass., succeeding H. L. Leighton.

MAJOR J. W. LEMON, whose promotion to superintendent of shops of the Missouri Pacific at Sedalia, Mo., was announced in the April issue of the *Railway Mechanical Engineer*, was born at Newton, Kans., on February 24, 1879. Mr. Lemon was educated at Pueblo, Colo., and on April 23, 1896, entered the employ of the Denver & Rio Grande as a machinist apprentice. In 1900 he entered train service on the Missouri Pacific as a brakeman between Pueblo, Colo., and Horace, Kan. In 1902 he became a machinist at Hoisington, Kans., and in 1910 was promoted to general foreman. He enlisted with the 31st Engineers, U. S. Army, in June, 1918, and served with the American Expeditionary Forces in England and France until October, 1919, when he returned to the United States and was discharged at Washington, D. C. In November, 1919, he was appointed master mechanic of the Central Kansas-Colorado Division of the Missouri Pacific, which position he held until his promotion to shop superintendent at Sedalia.

Purchasing and Stores

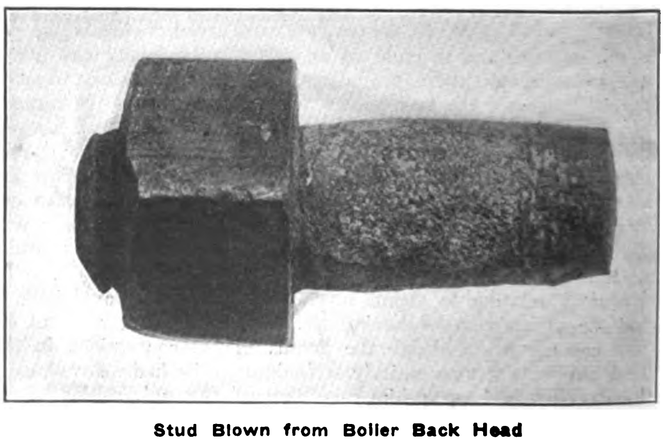
J. H. McGLOTHLIN has been appointed general storekeeper of the Virginian, with headquarters at Princeton, succeeding D. C. King.

L. C. THOMSON, chief of stores of the Canadian National, at Montreal, Que., has been promoted to manager of stores, with the same headquarters.

D. C. KING, general storekeeper of the Virginian, at Princeton, W. Va., has been promoted to purchasing agent, with headquarters at Norfolk, Va., succeeding Tom Moore, resigned.

G. W. CAYE, purchasing agent of the Canadian National, at Montreal, Que., has been appointed purchasing agent of the Grand Trunk Western lines, with headquarters at Detroit, Mich.

L. LAVOIE, purchasing agent of the Central region of the Canadian National at Toronto, Ont., has been promoted to general purchasing agent, with headquarters at Montreal, Que.



Stud Blown from Boiler Back Head

# Railway Mechanical Engineer

Vol. 98 June, 1924 No. 6

In the February and March issues of the *Railway Mechanical Engineer,* announcement was made that three prizes of $50 each would be awarded; one for the best paper on each of the three most important production jobs in the locomotive shop. Judging by the number of papers received, shop supervisors are far more interested in the driving box job than in either the rod or motion work jobs, and are least interested in the latter. Nine papers were submitted dealing with the driving box job, three dealing with the rod job and none at all dealing with motion work. What does this mean? Do the men in charge of the motion work job find the opportunities for improvement in their methods and organization too few to try their metal? Are the possibilities of the application of labor-saving devices lacking? Or is the lack of interest in the job shown in this particular case merely a matter of chance, devoid of any particular significance? The latter is, of course, quite possible and, beyond raising the question, we are not disposed to draw any conclusions.

The Production Job Competition

While the number of papers submitted on the rod job is small, one of them is a splendid and complete study of the work, which will be found of as much value for the suggestions it leaves in the reader's mind as for the specific information which it contains. This paper, to which the prize has been awarded, was written by M. H. Westbrook, superintendent of shops for the Grand Trunk at Battle Creek, Mich., and will appear in the July issue.

In the case of the driving box job, there were a number of valuable papers and a careful analysis was necessary before the prize-winning paper could be selected. The award was finally made to J. H. Hahn, machine shop foreman, Norfolk & Western, Portsmouth, Ohio. Mr. Hahn's paper will appear in the August issue.

In announcing the prize winners, the editors of the *Railway Mechanical Engineer* wish to express their appreciation to everyone of the contributors for their response to the announcements. A number of the papers will appear in later issues.

Apprenticeship on the Santa Fe

One of the high points at the meeting of the Mechanical Division last year was the splendid paper by John Purcell, assistant to the vice-president of the Atchison, Topeka & Santa Fe, on the training of mechanical department apprentices. Mr. Purcell clearly showed the remarkable practical results which had been obtained from the use of modern apprenticeship methods on the Santa Fe. He expressed these results in a conservative way, basing his judgment on experience extending over a period of 16 years. His observations were particularly gratifying to the *Railway Mechanical Engineer* because this publication and its predecessors have been aggressively advocating the principles underlying modern apprenticeship for almost a quarter of a century. The results, so far as the extended use of these principles is concerned, have come slowly. The Santa Fe, however, has promoted this work consistently through thick and thin. There may have been times when its promoters lost some of their faith and became down-hearted—if they did this, however, it has not been noticeable from the outside.

Not a few roads, inspired by what has been done on the Santa Fe, have adopted similar methods in the past few years. There have been some failures, but in such cases as have come to our attention, these can be clearly traced to the fact that departures have been made from those principles and practices which have been thoroughly tried out and have been successful on the Santa Fe. It is largely for this reason that the *Railway Mechanical Engineer* has arranged for the publication of a series of four articles, the first one of which appears in this number, which will describe at some length the apprenticeship methods as they are now being applied on the Santa Fe.

The attempt has been made to develop and clearly describe those methods and principles which are fundamental and which must be observed if the best results are to be obtained. One thing cannot be too strongly emphasized, and that is, that the shop instruction of the apprentice must not be left to a busy foreman or to an indifferent workman. It is absolutely necessary that competent shop instructors be provided and that the groups over which these instructors preside shall not be too large. It is not enough that these men are skilled mechanics, but they must also have a keen sympathy for the boys and special ability as teachers.

Developments in Railroad Shop Equipment

The development of machine tools and railroad shop equipment during the past year has been stimulated by the demand of the railroads for new and improved equipment. Some of the equipment has been required for new shops and terminals, of which a considerable number have been recently completed and placed in operation. Increased demands upon the maintenance of equipment departments have also had much to do with the introduction of new equipment and production methods. A number of the larger railroads are developing production shops at central locations on their lines, where locomotive and car parts are completed and then distributed to the various repair points over the system. The growth of these central shops has placed the railroads in the market for machinery designed to work on a production basis.

The requirements of heavy production work in railroad shops have been an important factor in recent machine tool design. This fact is emphasized by a review of the various new developments in shop equipment that have been described in the last twelve issues of the *Railway Mechanical Engineer*. Many of the improvements made on lathes, drill presses, planers and milling machines have been in the drive or feed mechanisms. This, of course, has increased the

productive capacity of these machines. A number of new flanging presses, shears and punches of large capacity have recently been placed on the market. An interesting development in this type of machinery has been the increased rapidity of operation which the designers have succeeded in incorporating into these tools. The need of portable equipment by the railroad shops has not been overlooked, for quite a number of machines suitable for enginehouses and outlying repair points have been placed on trucks or wheels so that they may be readily moved to points where needed. As a rule, these machines are driven by an electric motor, which can be plugged into the ordinary lighting circuit. A number, however, are driven by air motors designed to operate by compressed air furnished by the shop air lines.

A most marked improvement in shop equipment of all kinds has been the ingenious methods of lubrication. The importance of thorough lubrication, especially for the gears used in the feed or drive mechanisms, has been stressed in machine tool design in the past year. Many manufacturers are using automatic or forced feed lubrication on all bearings and an oil bath is usually provided for the gears. The later designs of lubrication systems also use the oil to better advantage and a great deal of the waste usually encountered in machines of earlier designs has been eliminated.

The rapid development of both the grinding and milling machines has also been an interesting feature in railroad shop work. The utilization of these machines is practically in its early stages and future growth depends to a large extent on how far the shopmen go in co-operating with the manufacturer in studying the possibilities of these machines. It is evident, from the extent to which many manufacturers have gone to the trouble and expense of studying railroad shop requirements, that there should be little difficulty in purchasing suitable and efficient equipment for all kinds of work. It is only necessary for the shop man to make his wants and requirements known. Anything from small hand tools to planers and presses of larger capacity and rapid production are available. There is no need to employ a large number of men to handle material, for trucks and cranes have been developed for the purpose of meeting the peculiar requirements of railroad shops.

One of the most common charges made against the railroads by both friends and enemies has been inefficiency in its maintenance departments. Inefficient shops are becoming more noticeable every day by their rarity, and for this the modern machine tool must be given its share of credit.

Engine Terminals Limit Locomotive Utilization

There are many evidences that railroad mechanical department men are asking themselves, "What can we do to increase the daily service hours and mileage of locomotives in order that a maximum return may be earned on the tremendous investment in this equipment?" In other words, the impression is sinking in that when a locomotive worth $60,000 or more is used in service only eight hours out of twenty-four and makes an average of but 81.5 miles a day (this was the average figure for serviceable freight locomotives, not stored, on Class I roads in the year 1923), something must be done.

The number of serviceable hours in 24 must be increased and the average daily mileage increased in proportion. The proposition has been advanced to establish a goal of 100 locomotive miles a day for serviceable freight locomotives not stored and apparently some roads are already doing something along this line. The Chesapeake & Ohio increased its serviceable freight locomotive mileage from 71.5 miles per day in 1922 to an average of 80.6 miles per day in 1923. C. F. Giles, superintendent of machinery of the Louisville & Nashville, advises that the average mileage per freight locomotive day on that road was 93 in January and 100 in February, based on the total number of locomotives owned. On the basis of locomotives in service the average daily mileage was 125 in January and 128 in February. There may be other roads which exceed the 100 miles-a-day mark but if so the great majority of railroads must fall considerably below that mark since the national average for 1923 was 81.5 miles a day.

What are some of the factors which limit locomotive utilization as expressed in service hours and average daily mileage? Obviously if a locomotive is in service eight hours a day in charge of the operating department it is in the hands of the mechanical department the other 16 hours, either undergoing heavy repairs in the back shop, being conditioned at the enginehouse, or awaiting call. The major portion of this time is spent in the enginehouse where many opportunities to improve present conditions may be observed. In some cases terminals are compelled to operate without modern equipment for handling coal and ashes. Sometimes machinery repairs are delayed by lack of machine tools. In other cases, boilers must be washed with cold water or the boiler washing plant has been outgrown so that locomotives are blown off to the pit with a resultant waste of steam and hot water which represents so many pounds of coal and hence dollars and cents. In other cases, for the lack of power trucks and crane facilities heavy locomotive parts must be removed from the locomotive, transported to the machine shop, returned and applied by manual labor.

The *Railway Mechanical Engineer* will welcome the comments of its readers as to the practicability of establishing an operating objective of 100 locomotive miles a day based on the number of freight locomotives in service. Suggestions regarding the enginehouse design, equipment, or methods of operation which will be most effective in increasing the ratio of daily service hours to non-service hours will also be welcome.

The Last Word on Shop Practice

In announcing the names of the prize winners in the machine shop production jobs competition, one of these papers was said to be of as much value for the ideas it suggested as for the specific information it contained. Indeed the same may be said of both the prize-winning papers. One of the strongest of the impressions made by these papers is the demand which progress makes for constant changes. Methods must be revised, the organization of personnel must be altered with respect to this or that detail of the work, and tools and equipment replaced if stagnation is to be avoided. It is clearly evident in both of these papers that the practices described are considered only temporarily satisfactory and that something better is expected and being sought. This is the penalty of progress.

On the other hand, it may be said that no shop can operate successfully if constant reorganization is under way and that to get the best results men must become accustomed to the performance of their work according to a certain routine and in a certain stable relationship to the work of others with which their own is correlated.

Here, then, is a direct conflict which must be taken into account in establishing a shop policy. Shall operations and methods be standardized and changes discouraged, or shall changes and readjustments be made at every opportunity? No doubt the logical solution is to be found in the adoption of a middle ground, where the effect of each suggested change of method, organization or facilities is carefully weighed in its relation to the other operations affected.

There are probably few individuals who are not susceptible to a feeling of pride in a good job well done. Too many of us, however, are inclined to make an occasional accomplishment last us for a long time. Wearing our

laurels, we lose sight of the fact that they soon wither. With this tendency in mind, is it not better to err on the side of liberality in the encouragement of initiative with respect to the development of refinements in shop operations and the search for better devices to facilitate the work, than to adopt fixed standards in the shop and thereby close the door to progress? There is no "last word" in shop practice and the supervisor who is mistaken on this point is likely to have his complacency rudely destroyed the first time he exposes himself to a fresh idea.

Study The Albuquerque Shop Article

Beginning on page 333 of this issue is an article describing in some detail the organization and operation of the Atchison, Topeka & Santa Fe locomotive repair shops at Albuquerque, N. M. While this article relates to production methods used in one of the largest and most modern railroad shops in the country, the principles involved are applicable to almost any locomotive repair shop irrespective of size. The article will justify the careful study and consideration of every alert reader of the *Railway Mechanical Engineer* who is interested in more efficient railroad shop operation.

While the shop buildings at Albuquerque are new and provided with the latest labor-saving machinery and equipment it is not maintained that all of this shop equipment would be justified at repair shops on small roads or even at minor repair points on large roads. The methods of scheduling operations, handling material and securing close harmony and co-operation between the shop employees and supervisors, however, may well be employed to advantage in any railroad shop not securing as desirable results along these lines.

In obtaining data for the article a dozen shopmen in as many different departments were approached in an endeavor to ascertain their attitude towards their work and towards the shop management. Almost without exception these men were found to be appreciative, loyal and in some cases enthusiastic about the comfortable, modern shop in which they worked and the kind of treatment they received. There is no doubt of the helpful effect of the shop council meetings and noon meetings referred to in the article. They make the men feel that Albuquerque shop is their shop. Moreover, the prompt redress of grievances, and their fair, everyday, man-to-man treatment shown the shopmen by their foremen and supervisors is conducive to a feeling of harmony without which no shop can be efficiently operated.

The work of scheduling locomotive repair operations at Albuquerque is handled by three men, an efficiency supervisor in charge of the scheduling or routing and two checkers. As a result of the operation of this schedule and the information made available by its records the different shop departments have been balanced and a certain amount of desirable friendly rivalry created between them. It should be noted that the shop schedule is set ahead of the performance actually expected. "The schedule is intentionally made short, with the idea of setting a mark to shoot at and thus keeping the various shop departments keyed up to a point where the production will approach as nearly as possible the mark set. A shop schedule which could be met by all departments is practically valueless." The coordination of a trucking service and material handling with the schedule is in line with what is coming to be the accepted practice in modern railroad shops.

One of the most important aids to systematizing work in the machine shop at Albuquerque and increasing the production in this vital department of the locomotive shop is the speed and feed chart attached to each machine, showing the kind of work to be done on every machine in the shop except three reserved for miscellaneous work. This phase of the work should be studied with great care, as it is believed to be carried out to a greater extent than at any other railroad shop. The organization of the flue shop with electric welding machines for safe ending the boiler tubes and flues is important as is also the organization of the erecting shop with specialized gangs under each foreman for handling special phases of the work.

Another essential feature of railroad shops not always given the attention its importance would warrant is the power plant, and the methods of reducing coal consumption at the Albuquerque power house are therefore particularly timely and of interest.

Any attempt to measure the effectiveness of the schedule and shop operation at Albuquerque would be valueless without taking due account of the importance placed on accurate, careful work and the heavy nature of the repairs given to the locomotives. For example, of the 302 locomotives repaired at the shops in 1923, 20 were given new fireboxes; 24, new cylinders; 39, new six-inch frames; and 24 were Mallets. An accurate analysis is made of the work expressed in man-hours per locomotive, enabling the shop management to know just what is accomplished and giving an intelligent basis of comparison with other years.

New Books

SHORT CUT METHODS FOR CARMEN. *By Hugh K. Christie, formerly air brake supervisor on Pere Marquette Railway and director of trade education for the Brotherhood of Railway Carmen,* 188 *pages,* 5 *in. by* 7¾ *in. Price* $2.00. *Published by the Simmons-Boardman Publishing Company,* 30 *Church Street, New York.*

The text of this book covers in a simple, practical fashion 103 devices and methods by which the car repairmen can repair cars with a minimum amount of labor. The author has had wide experience in the car repair field and is well qualified to recommend practical suggestions as to the best way to help lighten the car repairman's work. The book is well illustrated and is written in the language of the carmen. It will be to the advantage of the car repair foreman and his men carefully to study the text of this book which will obviously convince them of the many ways there are of improving the methods of repairing cars.

What Our Readers Think

A Reference Filing System

DUNKIRK, N. Y.

To the Editor:

In the May issue of the *Railway Mechanical Engineer,* J. Boyd inquires for a convenient and practical way of filing and indexing engineering notes, data and articles.

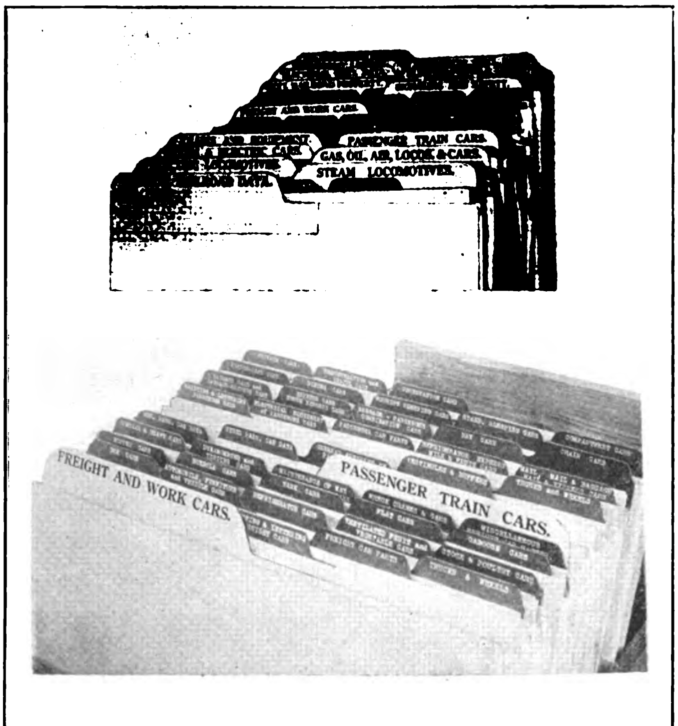
First, I would recommend the purchasing of a four-drawer, correspondence size, vertical all-steel art metal cabinet. A wooden file cabinet will not prove entirely satisfactory because the drawers will become so heavily loaded in time that it will be difficult to slide them. The steel cabinet is provided with a Yale lock which makes all the contents of the drawers secure from tampering.

The next step is to secure a quantity of new or used one-fifth cut tabbed guide cards, some sheets of heavy pressed cardboard, half an inch deeper than the regular tabbed guides, and also a number of heavy folders with creased bottoms to allow for expansion as they are filled up.

A list then should be made out of the suitable main divi-

sions and sub-divisions for making the guides. From the sheets of the cardboard large guide cards are cut and marked for the main divisions, these being tabbed one-half cut and standing a half-inch higher than the regular guides. The smaller guides are then marked for the sub-divisions and the tops of the folders neatly marked with printed or typewritten labels. Comprehensive filing of data can now be started.

It is necessary that all the guides should have easily read labels or it will be found slow work to find and refile data. The wording for the main divisions should be set up in printers' type of a suitable size and style. The type should be inked with regular printers' ink, white paper laid on the type and pressed down heavily through a pad of blotting paper. The impressions are then carefully pulled off and laid aside to dry in a warm room. Several impressions of



A Filing Index for Keeping Railroad Data and Engineering Notes

each title should be made to allow for spoilage and any future extension of the system.

In order to avoid a lot of tedious composition in small type it is advisable to produce the labels for the small tabs by the typewriter method. As colors play an important part in filing systems by enabling the eye to quickly pick out any tab or group of tabs, it is possible to speed up the system by the judicious use of suitable colors. Therefore, a color scheme for the tabs should be laid out. Some of the labels may be typed directly upon white or colored papers, using a well inked ribbon. Others are made with white lettering and a dark blue background by the blue-print process, using negatives of thin white bond paper typed with a well inked ribbon and backed by carbon paper. Care should be taken to obtain deep blue-prints.

The labels are then roughly trimmed to size, the tabs glued and the labels folded over the tabs and attached. When quite dry, the labels are carefully trimmed to the shape of the tabs, sized with thinly diluted glue and again dried. Three coats of celluloid-base clear lacquer is then applied, leaving a transparent coating of celluloid, glossy and washable. The sizing is necessary to obtain a smooth finish by filling the pores of the paper and also to fix the typewriter ink which otherwise will dissolve and run in the lacquer. I found these tabs to be as good as when made after eight years of usage.

The scope of the file can be enlarged from time to time until the major divisions include engineering, scientific and general subjects other than railway engineering. The sub-divisions are, of course, arranged to suit the writer's own particular ideas and needs, but the file may be arranged for only railway engineering matter. A list of divisions and sub-divisions in railway engineering included in this filing system will be furnished to any reader on receipt of addressed envelope.

Mr. Boyd speaks of copying engineering articles. This is a laborious process of acquiring information and consumes time worth more than the price of the magazine, beside which, the illustrations cannot be copied. A far better method, which the writer has used for twelve years, is to subscribe to the leading railway and general engineering magazines and to dissect them after reading, filing the useful articles, illustrations and data under proper headings. This method collects into one folder all the available matter on that subject, instantly accessible, which otherwise would be scattered through hundreds of magazines. Matter not needed can be discarded. A large photo print trimmer can be used to trim off the tops, bottoms and binding edges of pages to fit the folders. A ticket punch used on top or right edge of pages will identify all the sheets of an article easily and surely. The value of such a filing system, if kept up to date, cannot be estimated. To the writer's file is added every year the heart of one hundred and fifty railway and general engineering magazines, both weekly and monthly. It contains practically everything of permanent value that has been printed in the leading American railway engineering periodicals in the past twelve years, together with much earlier matter of value.

ARTHUR W. LINE.

A Small But Important Item

MECHANICSVILLE, N. Y.

TO THE EDITOR:

A much abused and neglected part of railroad equipment is the cotter key. The importance of this item is too often disregarded by the class of labor to whom its application is usually left. The throttle rigging, motion work, rods and brake rigging jobs are not completed, mechanically, until cotter and split keys are put in and properly split, bending both sides.

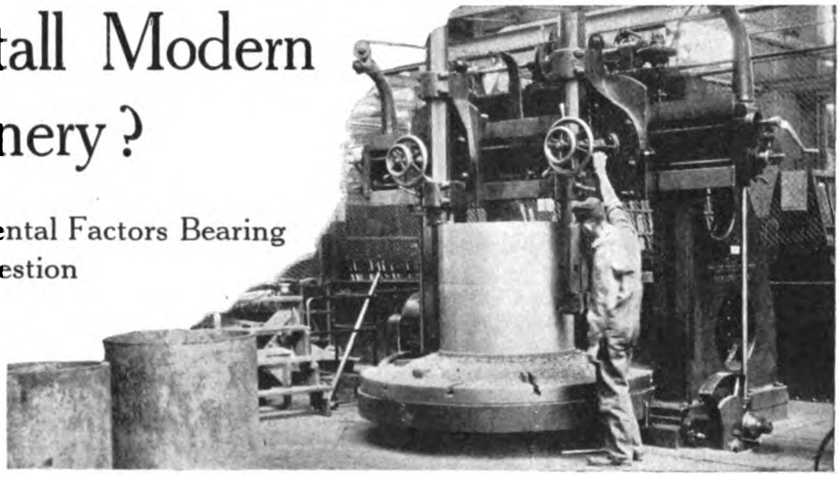
Throttles become disconnected and are dangerous as well as expensive, especially if they become disconnected on the road. Motion work pins coming out cause serious failures, distorting or breaking expensive parts. The loss of side rod knuckle pins is a frequent causes of rupture to boilers. Brake rigging coming down causes derailments to cars as well as locomotives and in the case of such an occurrence in a tunnel or on a bridge loss of life or serious accident to personnel or equipment may result.

If the car inspector and locomotive inspector were forced to ride a fast freight in the caboose cupola or locomotive cab, where the swaying of the cars, and the rapidity with which the moving parts of a locomotive are working is emphasized, a closer inspection of these parts would result and the trouble would be eliminated.

The honor rolls on some of our railroads contain a high percentage of cases where brake rigging has been discovered dragging, and the train stopped in time to prevent derailment. Many serious accidents are due to the loss of such a small part as a cotter key.

A FOREMAN.

Does It Pay to Install Modern Shop Machinery?



A Discussion of Some of the Fundamental Factors Bearing on this Important Question

By C. A. Shaffer

WHEN it comes to the matter of asking for authority for expenditure (A. F. E.) to cover the purchase and installation of new tools and machinery, the first questions which naturally arise are, what is the necessity for the new tools and what saving can be realized by their use?

In order that a convincing argument may be presented in favor of having good machinery in the shops it is essential first that accurate figures be obtained as to the cost of installing the new machines, taking into account all known items such as initial cost, cost of motor equipment, wiring, foundations, etc. Figures should also be obtained showing the cost of doing specific work with existing machines and a careful, comprehensive comparison made of the unit labor cost of doing the same work on modern high-powered machines. If a new machine, for example, costs $10,000 and will show savings of 18 or 20 per cent on the investment, as it frequently does, there can be no question as to the advisability of installing the new equipment. With a machinist receiving from 72 to 85 cents an hour in 1924, the management can well afford to install production machines which would not have been justified in 1914, when the rate was 34 to 39 cents an hour.

Other items than labor cost, however, must be taken into consideration, such as the speed of performing certain operations in the machine shop in order that the required shop output may be obtained and sufficient motive power kept in serviceable condition to handle the traffic on the road in question.

Volume of Work an Important Consideration

In the larger shops where a considerable amount of machine work of different kinds is done and all machines are kept busy most of the time, it is comparatively easy to determine whether it will pay to replace certain old tools with new ones. Replacement may be necessary for one or more reasons usually on account of the generally worn-out condition or obsolete type of machines or designs not adapted to the work for which the machines have to be used. There are also cases where the physical condition of certain machines may be fair but they are of old, light pattern and insufficient capacity to handle present day work at heavy cuts and high speeds. It often happens in shops where old and badly-worn machinery is used that the best mechanics must be employed on machine work of perhaps secondary importance in order that the time may be reduced as much as possible, and that there may be a reasonable assurance of obtaining an acceptable quality of work. In many cases mechanics have operated the same old machines continuously for 10 or possibly 15 years and, knowing all of their idiosyncracies, are able to get a fair production and reasonably accurate work. New men, however, unfamiliar with these machines, would perhaps spoil enough work in one day to more than amount to their month's wages. Old planers, for example, sometimes plane out of true as much as 1/32 in. to the foot and by the judicious placement of wedges an experienced operator can overcome this inaccuracy. This, perhaps, would not be discovered by a new operator until after he had done serious damage. Nothing is gained in most cases by using poor shop equipment when figured on a cost per hour basis as it takes a good man to produce even fair work with poor tools.

Roundhouse Should Have Good But Not Single Purpose Tools

At less important points on a railroad where there is only an occasional job of machining of a wide variety of work incidental to running repairs it seldom pays to install costly, single-purpose machines. This statement, however, should not be interpreted to mean that a worn-out, good-for-nothing tool can profitably be transferred from the back shop to a roundhouse where the roundhouse foreman already has troubles enough of his own without trying to maintain a machine tool fit only for the scrap pile. In the medium and larger-size shops, when labor costs and quality of work are considered, it will usually be found a good saving on the investment to replace the old, obsolete and badly worn machinery with the best equipment obtainable for doing the work. In this line good results are not only obtained from complete, high-grade equipment of special and automatic machines but much benefit may be derived by the conversion of existing machines or by the application of improved attachments which may serve to more than double the output.

Further advantages of modern machinery include the individual or unit electric motor drive which greatly increases the flexibility of the machine shop and prevents tying up the entire shop as would be the case with light machines driven from a line shaft when an accident occurs to the main driving engine or motor. In addition, when for any reason one machine is required to be operated nights or holidays it can be started and operated as long as necessary without the power waste involved in operating a big driving unit and a long line of shafting.

Mention will be made in the following paragraphs of savings which have occurred in ordinary locomotive and car work with standard machines or those commonly found in the average railroad shop, which would easily justify the expenditure for better equipment.

Boiler Shop Machinery

One of the most important machines in the modern boiler shop is the combination punch and shear, the entire output of

the boiler shop being more or less dependent on its ability to handle promptly this class of work. Many shops are still equipped with the older type of punching and shearing machines having a throat depth not exceeding 42 in. As a consequence, with the advent of the modern locomotive and large boiler sheets up to 120 in. wide, the old machines will not punch to the center of the sheets. The common practice, therefore, is to punch a series of holes on either side of the sheet as far as the punch will reach, a large number of holes in the center being left to be drilled on a radial drilling machine or, if that is not available, with a portable pneumatic drill and "old man." The labor cost of the latter method in particular is obviously high and a considerably longer time is required to complete the work on boiler sheets, which may delay the boiler work to such an extent that locomotives badly needed for hauling trains are subjected to otherwise unnecessary delays in the back shop.

The remedy is to provide modern punches and shears with 60-in. throat depths, or whatever depth may be required to punch to the center of the largest boiler sheets on that road. The same comments regarding punching machines apply to machines used for shearing boiler plate.

In many shops it is advisable on account of limited space to consider universal machines which will punch and shear the largest plates and also shear all structural shapes and bar work. Some of these designs have unlimited shearing capacity as regards the length and width of boiler plate which may be cut. In deciding on the universal machine this important advantage should be remembered: The three operations of punching and shearing boiler plates and shearing structural shapes can be performed simultaneously or independently, with the result that in relatively small shops one universal machine can be kept practically in continuous operation during working hours. Special dies are made for these machines to shear the several sizes of round bar stock most suitable for staybolts. The dies operate to shear the bolts square with the center line, a small, but important feature when it comes to centering the bolts for subsequent machining or drilling tell-tale holes.

Radial drills of 60 to 72 in. diameter are needed in most boiler shops to take care of all important drilling of large sheets and reaming for tube and flue holes. The rapidity and power of the modern radial drill gives it a production which, from the point of view of reduced labor cost and reduced time required for drilling operations, makes it easy for this machine to show a substantial saving over older drilling machines built before the days of high speed steel. Radial drills are also used for countersinking boiler sheet holes for all large openings required.

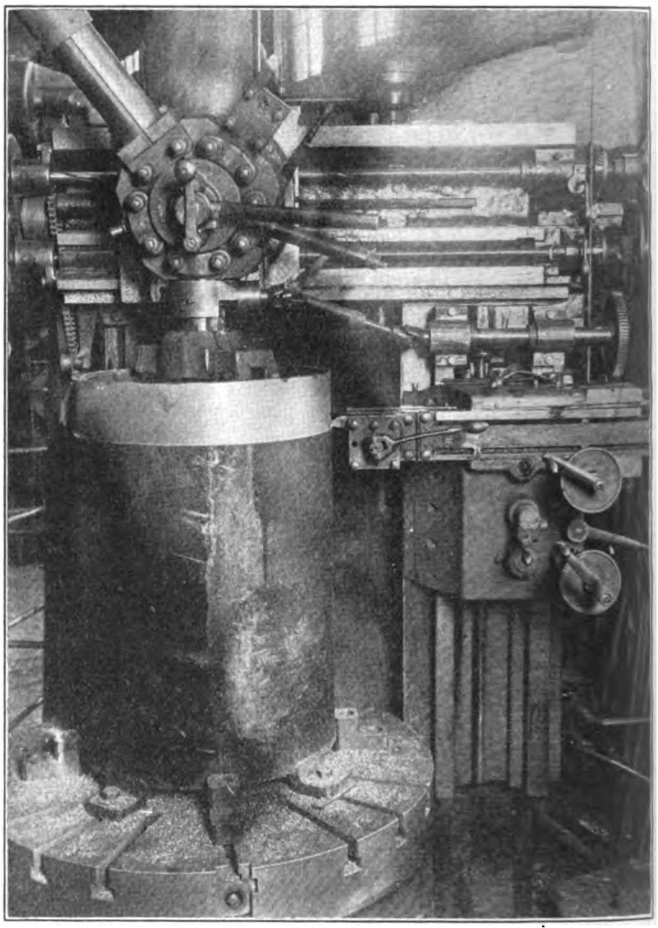
Blacksmith Shop Equipment

The increasing size and weight of locomotives and car parts has been instrumental in making many railroad blacksmith shops out of date as regards to steam hammer equipment. Not many years ago 900-lb. to 2,000-lb. steam hammers were ample for most of the work handled in railroad blacksmith shops, but today, outside of light or special work, less than 2,500-lb. or 5,000-lb. hammers are seldom installed. Large forgings can be turned out on these machines in a fraction of the time required with light hammers, which are about as effective on modern heavy locomotive parts as a woodpecker on a tin roof. The modern heavy hammer has an advantage from three points of view: Forgings can be completed at one heat, with a resultant saving of fuel, saving of labor while waiting for forgings to heat, and saving of the time and labor required for the operation.

Modern forging machines are at least three times as productive as the earlier types and represent a marked improvement in speed of operation and consequently reduced unit cost. Almost every railroad blacksmith shop has a large amount of bolt heading work to do and on the earlier types of bolt headers hand operation was required to turn the bolt after each stroke until the bolt head was formed. With the new machines the head is formed at one or at most two strokes of the forging machine ram and the resultant increase in production in the course of an eight-hour day assumes important proportions. The dies for forging machines deserve and receive a great deal of consideration in view of their cost and effect on the quality of the work. Expensive dies should not be made unless there is a sufficient volume of work to warrant. Conditions vary so much at different shops that the figures which apply at one may not apply at another.

Machine Shop Tools

A machine shop tool, the installation of which is justified and in fact is usually compelled by lack of capacity of old equipment, is the driving wheel press. Old presses which



A 54-In. Vertical Turret Lathe Equipped with Double Cutter Head Boring Bar for Machining Cylinder Bushings

have been in service from 12 to 15 years usually have a capacity of 300 to 400 tons and are used for applying wheel centers to driving axles. These presses were adequate when axle size was limited to 8 or 9 in. but since the advent of 11 and 12 in., or larger, axles the old presses will not develop the required tonnage. As a result, where new and more powerful presses have not been installed, it is still the custom to drill a sufficient number of holes in the end of the axle close to the wheel seat so that the metal in the axle will give way and allow it to be forced out with the old press. Not only is this drilling a costly, time-consuming operation but the axle is spoiled for further use. A modern 600-ton press is required to handle this work satisfactorily and the installation of such a press is justified even in shops where it is used only a few times a day. The decision regarding how much work must be necessary to justify installing a big modern press must be made after a consideration of the

distance from the nearest large shop equipped with such a press and the loss from holding locomotives out of service at the point in question while driving wheels are shipped to and from this shop.

Specific Jobs Which Justify Machine Replacements

Driving Wheel Tires—In turning tires mounted on wheel centers in modern 90-in. driving wheel lathes the average depth of cut is 7/16 in.; the approximate cutting speed, 14 ft. per min.; the approximate feed, 3/8 in. per revolution, and the average time complete, floor to floor, 1¼ hr. The machine formerly used for this work, while of the same size, was of much lighter pattern and on account of its worn condition and lack of strength to withstand the heavy cuts and feeds, it required from 4½ to 7 hr. to turn a pair of driving wheel tires, depending mostly on the character of the material and the size of the tire. It is obvious that in shops where any considerable amount of such work is to be done, it will pay to purchase the up-to-date heavy-duty machines even if they stand idle a part of the time.

Car Axles—A modern, combination axle lathe can be used to advantage in most shops for machining the wheel seat and journal bearing complete and the rolling of the journal bearing, also turning and rolling cut journal bearings with the wheels mounted on the axles. The main saving effected by the use of the new type combination lathe is effected by reason of the fact that the machine is suitable for both new work and the reconditioning of cut journal bearings with wheels mounted on the axles during the latter operation. With the use of the old style axle lathes which do not have sufficient swing to handle axles with wheels mounted, it is necessary to press the wheels off before the axles can be machined and in doing this the proper fit on the wheel seats is usually destroyed and it is necessary to fit other axles to the wheels.

Locomotive Piston Heads—In machining 28-in. piston heads on a 36-in. vertical lathe the average time is 1½ hr., faced, turned, grooved and bored complete; the average depth of the cut, 7/16 in.; the approximate cutting speed, 40 ft. per min., and the approximate feed, .068 in. per revolution. The time for this work formerly done on an old engine lathe averaged 3½ hr.

Piston Rods—Locomotive piston rods are machined on a 24-in. high duty engine lathe. They are turned and rolled complete. The average depth of the cut is 3/16 in.; the approximate cutting speed, 30 ft. per min. and the approximate feed, 1/16 in. per revolution. On the above machine, in turning piston rods of chrome vanadium material, for example, the machining time is cut approximately 40 per cent over that obtained with the use of an old engine lathe which would not permit the taking off of the metal to the full capacity of high speed steel cutting tools.

Button Head Radial Crown Staybolts—These bolts are turned on a 2-in. by 24-in. turret lathe equipped with a special attachment. The operation consists of turning, facing under the head, necking and threading at both ends, complete. The average time is 2 min. per bolt. This work was formerly handled on different machines, the operations being distributed between the bolt cutter, engine lathe and turret lathe, and it required from 8 min. to 25 min. per bolt to complete the job. With the new commercial staybolt threading devices which have been quite well developed, it is possible to utilize an old, replaced turret lathe and by application of the new, inexpensive threading attachment, first-class work can be turned out at a good saving.

Shoes and Wedges—Shoes and wedges are machined on a 36-in. shaper. The operation of planing on the driving box face, complete, averages 20 min. for each piece on a set of eight shoes and eight wedges. This work, formerly done on an old shaper or planer, required an average of 40 min. for each piece on account of the equipment used being inadequate to handle the work properly in good time.

Locomotive Frames—The work of drilling frames is handled on a 60-in. radial drill, the average time complete per pair of frames being 7 hr. The time required for drilling the same number of holes in similar class frames on former old machines used for this purpose averaged 16 hr., this being due to the condition of the machine and the fact that it did not have the capacity for driving high speed steel drills at proper speeds and feeds.

Guide Bars—An 84-in. face grinder is used for grinding on the face and two sides. The average time per guide ranges from 50 min. to 1 hr. 25 min., depending on the size of the guide and the depth of wear which must be removed. This work, formerly done on the planer, required from three to five hours and the surfaces were not as smooth as when ground.

Cylinder Bushings—These bushings, with a finished size of 30 in. by 32 in., are machined on a 54-in. vertical lathe, using a double cutter head boring bar in the turret head for boring simultaneously when turning with the side head. Turned and rough bored, the average time is 3¼ hr.; the average depth of the cut, 5/16 in.; the approximate cutting speed, 38 ft. per min., and the approximate feed, .131 in. per revolution. The time for this work, formerly done on an engine lathe of insufficient swing, necessitating the use of raising blocks under head and tail stocks, ranged from 12 to 28 hr., depending on the machine used.

Driving Boxes—The average time for boring crown brasses and facing hub liners on a 42-in. vertical lathe is 35 min. a box. The time for this work, formerly done on an old boring mill or engine lathe, averaged 2¼ hr.

Machine Tool Budget Forms

Typical examples of Illinois Central machine tool budget sheets are shown in the accompanying tables, an examination of which will indicate the care given to determine all elements of cost in installing new machines and removing old ones, and the annual savings expected to result from the installation of new machines. Moreover, checks are made from time to time after the new machines are in operation to determine if the expected savings have materialized.

Table I shows a typical sheet from the 1923 budget for

TABLE I—TYPICAL LIST OF NEW SHOP MACHINERY ON THE 1923 BUDGET FOR A MEDIUM SIZE SHOP

No.	Motor	Description	Shipping weight, lb.	Costs: Machine	Found'n	Wiring	Instal'n	Store exp.	Frt.	Total	Est. annual saving
1	10	2—18 in. by 3 in. by 1½ in. double electric floor grinders	3,600	$1,000	$60	$100	$40	$5	$3	$1,208	$1,800
2	5	1—20 in. by 10 in. engine lathe and motor	8,000	3,000	30	50	50	15	2	3,147	375
3	5	1—20 in. by 10 in. engine lathe and motor	5,000	2,070	30	50	40	10	2	2,202	300
4	7½	1—100-ton forcing press and motor	10,000	2,000	50	75	50	10	..	2,185	325
5	3	1—Universal tool and cutter grinder and motor	1,000	1,050	10	30	10	5	1	1,106	250
6	50	1—54 in. truck wheel lathe and motor	80,000	13,500	400	500	400	70	41	14,911	1,800
7	15	1—Universal punch and shear (car work)	40,000	5,700	100	150	100	29	30	6,109	700
8	..	2—Portable electric rivet heaters (4)	4,000	3,000	...	1,000	...	15	3	4,098	650
9	75	1—16 in. by 20 in. timber sizer and motor	20,000	6,000	300	750	130	30	10	7,220	1,000
10	15	1—500-lb. power hammer	9,000	2,300	50	150	50	12	16	2,578	400
11	..	1—Pneumatic cold flanging machine, ¾ in. capacity	10,000	5,000	30	...	50	10	10	5,100	600

a medium size shop and Table II the machines which will be replaced by those listed in Table I. The following comments regarding the individual items in these tables may be of interest.

Item 1—Old grinders to be relieved because they are too

TABLE II—TYPICAL LIST OF RELIEVED SHOP MACHINERY REPLACED BY THE MACHINES LISTED IN TABLE I

Item No.	Machine	Age, yrs.	weight, lb.	Disposition	Costs Original	Found'n	Instal'n	Misc'l	Total	Salvage	Removal cost
1	1—Floor grinder (belt dr.)	19	1,700	Retire	$190	$9	$3	$1	$203	$8	$5
	1—Floor grinder (belt dr.)	10	700	Retire	75	..	4	..	79	3	3
2	1—Engine lathe	18	4,000	Retire	450	..	16	1	467	20	20
3	1—Bolt cutter	22	2,000	Retire	400	..	..	..	400	10	10
4	1—Forcing press, 50-ton	8	3,000	Transfer	827	25	150	..	1,002	..	50
5	1—Cutter and reamer grinder	16	1,000	Retire	685	..	18	2	705	5	10
6	1—42-in. car wheel lathe	16	40,000	Retire	4,000	62	66	39	4,167	200	100
7	1—Double punch and shear, and motor	30	19,000	Retire	1,260	31	20	5	1,316	100	50
8	2—Forges	7-8	600	Retire	100	..	..	..	100	5	2
9	1—8 in. by 30 in. wood planer	31	15,000	Retire	2,200	53	28	6	2,287	75	50
10	....	..	.....	.....	....	..	..	..	.....	..	..
11	1—Hand flanging clamp	8	6,000	Retire	250	10	18	3	281	30	20

light, not powerful enough, or in poor condition and dangerous to operate. The proposed new grinders are heavy-duty, ball-bearing, self-contained and motor-driven. Because of their efficiency, they will show a satisfactory saving.

Item 2—An old engine lathe of light design and generally inadequate to handle the work. The type and physical condition will not warrant general repairs being made. The new engine lathe is to be of the latest design, heavy-duty type with all necessary modern attachments. It will make a saving of at least 40 per cent of the time required to perform the work now being done on the old machine.

Item 3—Bolt cutter, to be relieved on account of age and general worn out condition; it will not produce good threads. On general work comprising various sizes, the special adjustment feature on the new machines alone as a production factor will pay in a short time for the replacement, aside from the consideration of the quality of the work.

Item 4—Forcing press, to be relieved on account of insufficient capacity to handle work on large driving boxes and other large pieces. A new machine of double the capacity is recommended, and the lighter one, which is in fairly good condition, will be transferred to another shop for use on lighter work.

Item 5—The present cutter and reamer grinder has served its purpose for grinding small, light tools but it will not handle the heavy tools now being used on the machines, particularly locomotive reamers and large milling cutters such as are used on rod work. The length of these milling cutters exceeds the capacity of the old machine and they have to be shipped to another shop for grinding, which is expensive and causes much delay to the work.

Item 6—The present car wheel lathe is in a generally worn out condition and requires eight times as long to turn a pair of engine or tender truck wheels as would be required on a new, up-to-date machine, the size and design of which will also be suitable for taking care of trailer wheels up to 54 in. in diameter.

Item 7—The present punch and shear is badly worn and will only punch holes or shear material up to about one-half the size required. Holes larger than this machine will punch must be drilled and shear work beyond the capacity of the machine is cut with an oxy-acetylene torch. The proposed machine will handle all sizes and a much greater variety of work, with a very considerable saving in time.

Item 8—Forges used for heating rivets are in bad condition and expensive to operate, and on account of existing conditions are considered bad fire hazards. Because of the nature of the work, the new electric rivet heaters will effect a reasonable saving and be more desirable to operate.

Item 9—The old wood planer, used for planing car sills and other similar work, is a double head machine and owing to its light construction, long timbers must be passed through repeatedly in order to bring them to the required size and condition. This is very expensive from the standpoint of labor costs as the heavy timbers are hard to handle, especially on the back up movements in a mill room, which is more or less congested. The new machine will be a heavy-duty, four-side type and require but one operation to plane a timber on all four sides to the required dimensions. On a similar installation at another shop, work of this character was performed in less than one-third of the time required to do the same amount of work when the old machine was used.

Item 10—The electric driven power hammer is recommended for miscellaneous blacksmith work in the car department. It does not replace another machine, but will take care of work now requiring several men with hand sledges.

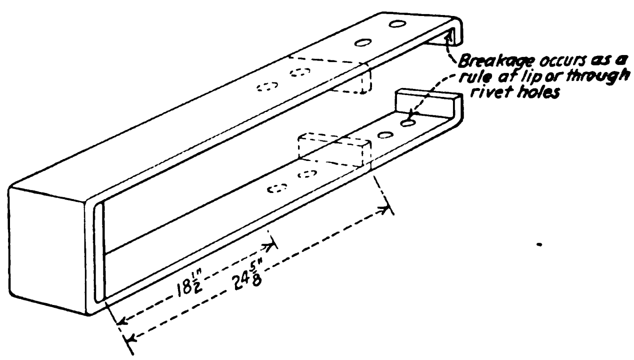
Item 11—A considerable amount of flanging of various pieces for locomotive and car repairs is done by heating and then flanging by hand with mauls while held in a clamp. Better and quicker work with a resultant saving can be obtained in this case with the new power machine.

Reclaiming Coupler Yokes

By A. H. Anderson

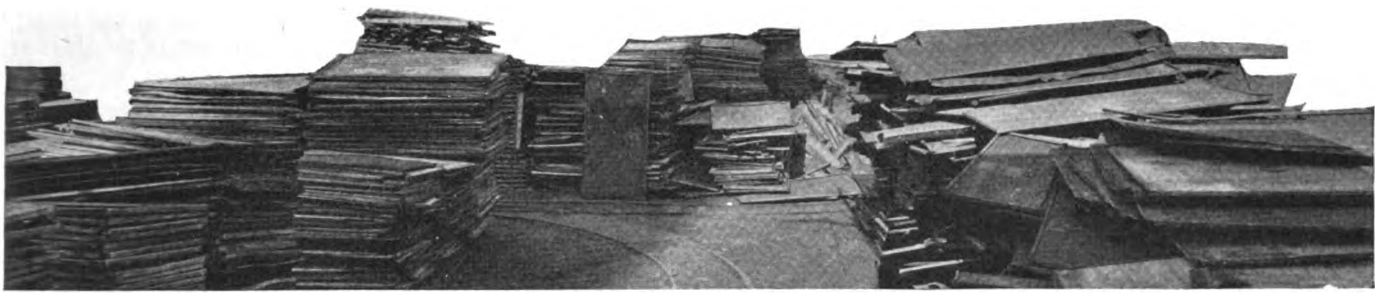
Foreman, Indiana Harbor Belt, Gibson, Ind.

THERE are a great many cars in service equipped with friction draft gears that have wrought iron, 5-in. by 1¼-in., riveted yokes. The standard inside measurement for these yokes is 24⅝ in. from the back of the coupler to the face of the yoke block. When the yoke has to be renewed, it means a material cost to the car owner. However,



Yokes, 24⅝ In. from the Back of the Coupler to the Face of the Yoke Block, Can Be Reduced to 18½ In.

this size yoke can be made over into an 18½-in. by 9⅛-in. butt coupler yoke, as shown by the dotted lines in the sketch, at small expense. Any fair sized repair track will average at least two such yokes a day and by the use of this method of reclamation a considerable saving can be made in the course of a year.



Roof Sheets Are Removed with Care to Prevent Damaging Them

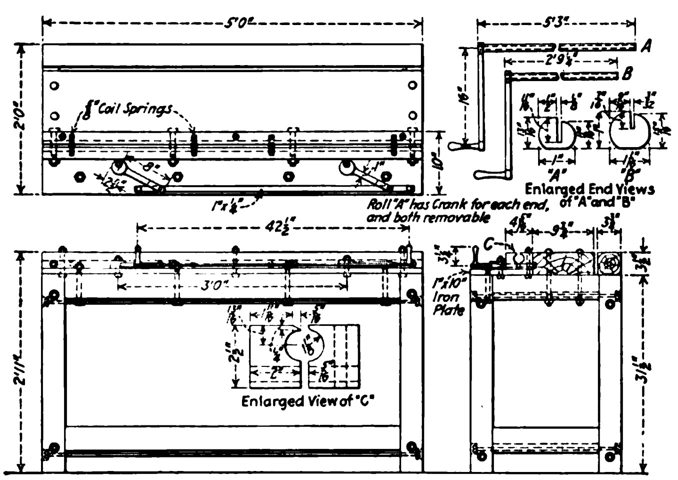
Central of Georgia Reclaims Metal Car Roofs

Sixty Per Cent of All the Sheets Removed Are Restored to Service at a Cost of $10 Per Car

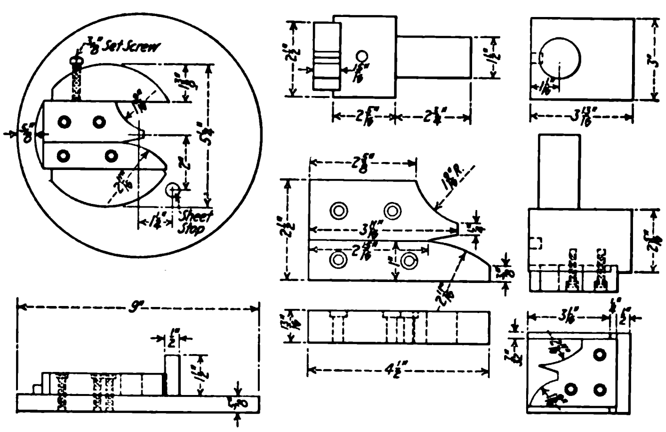
By W. H. Harrison

Foreman, Pipe and Tin Shop, Central of Georgia, Macon, Ga.

In March, 1922, the Central of Georgia built at its Macon, Ga., shops a plant for reclaiming the galvanized sheets of flexible metal car roofs and restoring them to further use as car roofing material. It has been found possible to reclaim an average of 60 per cent of the sheets removed. The reclaimed roofs are divided into two classes. Those in the first class are made of material selected from the best of the reclaimed sheets, containing the least number of defects, and are considered to be good for eight or more years of service. These roofs are applied on steel underframe cars. The roofs in the other class are made up of material containing a greater number of defects, but which still is considered to be good for five or six years service. These are applied to wooden underframe cars.

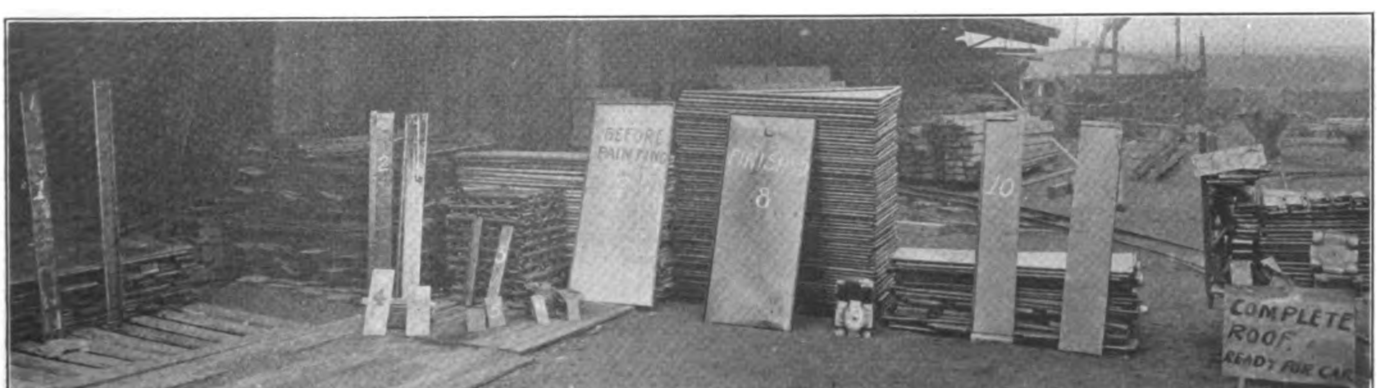


Turning Machine for Folding the Edges of Roof Sheets



Dies Used for Stamping the Corners of Roof Sheets

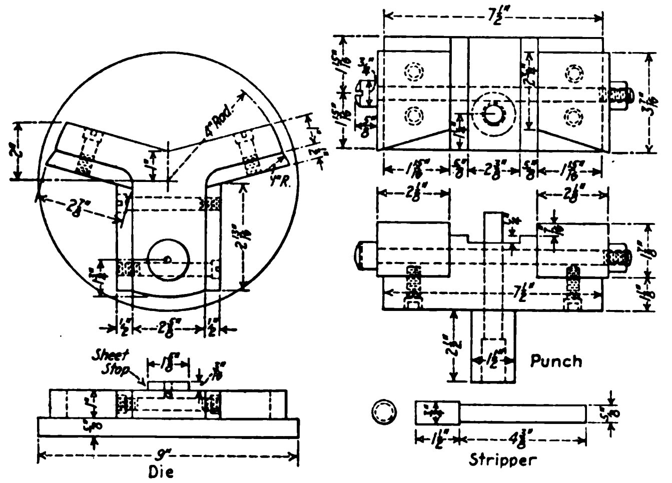
The equipment required at the plant is not extensive. It consists of one Niagara No. 662 gap shear, one Slaysman



The Parts of a Reclaimed Roof: (1) Long Transverse Cap; (2) Flashing; (3) Ridge Cap; (4) Supporting Pieces; (5) End Caps; (6) Saddle Cover Caps; (7) Sheets Before Painting; (8) Finished Sheets; (9) Crown Cap; (10) End Finishing Pieces; At Right—Complete Roof Loaded on a Shop Car

No. 4 stamping machine, with a complete complement of dies which were made at the Macon shops, one home-made folding machine, a home-made hand brake for turning the edges of flashing sheets and the lower ends of roof sheets, a home-made air press, which is used for straightening sheets and for forming crown caps, and a dipping vat with side racks on which the sheets are placed to drip after being dipped in the paint.

When the car roofs are renewed because they are leaking or in generally bad condition, the metal sheets are removed with more care than was the case before the reclamation plant was built. All of the removed sheets are thoroughly inspected and those which can be reclaimed are sent to the shops. Those which are of no further use are then scrapped.

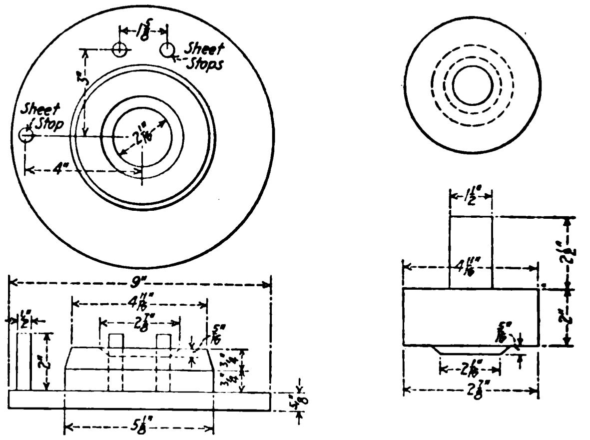


Dies Which Cut the Top Corners of the Transverse Caps

The roofs are reclaimed in lots of from 30 to 90 each. After the sheets are sent to the reclamation plant, they are first separated into the two classes, the best of which includes material which can be used again by straightening the edges and soldering up a few nail holes, and the poorer of which includes the material that must be entirely reworked before it can be reapplied.

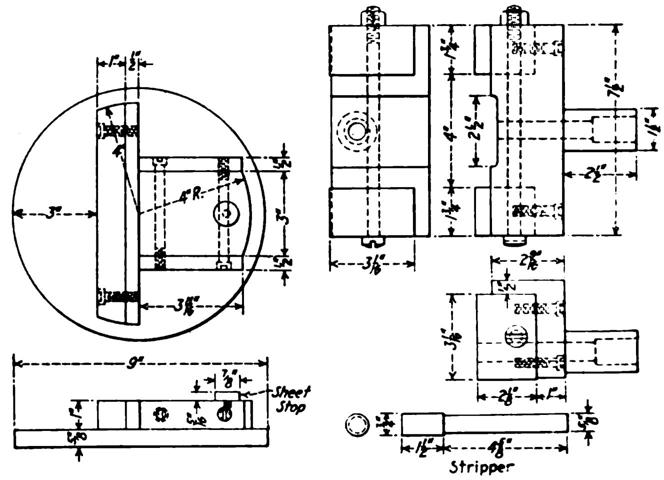
Where the sheets have their corners and edges broken, they are trimmed in a shear on all four sides. The four corners of each sheet are then trimmed in the stamping machine with a special set of dies the contour and construction of which is shown in one of the drawings. These dies make a neat job and when the sides and upper ends are folded, the top corners have projections which are bent over and soldered, making an effective lock.

Three edges of each sheet are then folded in the turning machine, after which two inches of the bottom of the sheet are



These Dies Form the Raised Discs on the Roof Sheets and Supporting Pieces

folded under on the brake. The dies for making the impressions for the swivel supporting disk are then set up in the stamping machine and this operation is completed for the lot

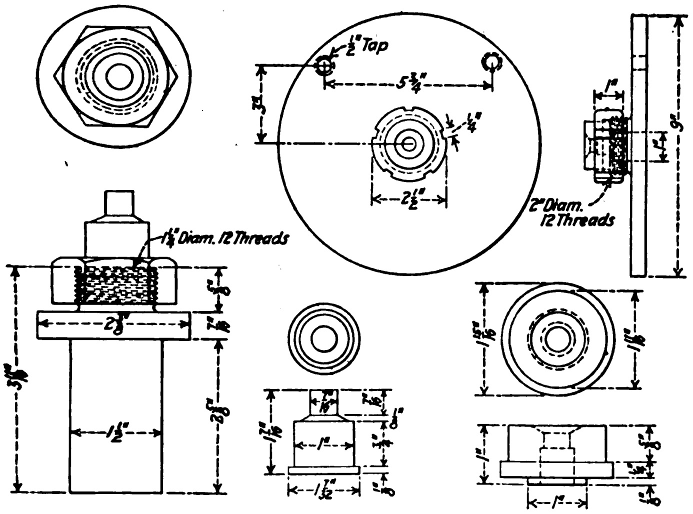


Dies for Stamping the Bottoms of the Transverse Caps

then going through the shop. This completes the machine operations and each sheet is next carefully examined for nail holes, or other slight breaks, which are soldered. The sheets are then dipped in the paint, and are ready for reapplication.

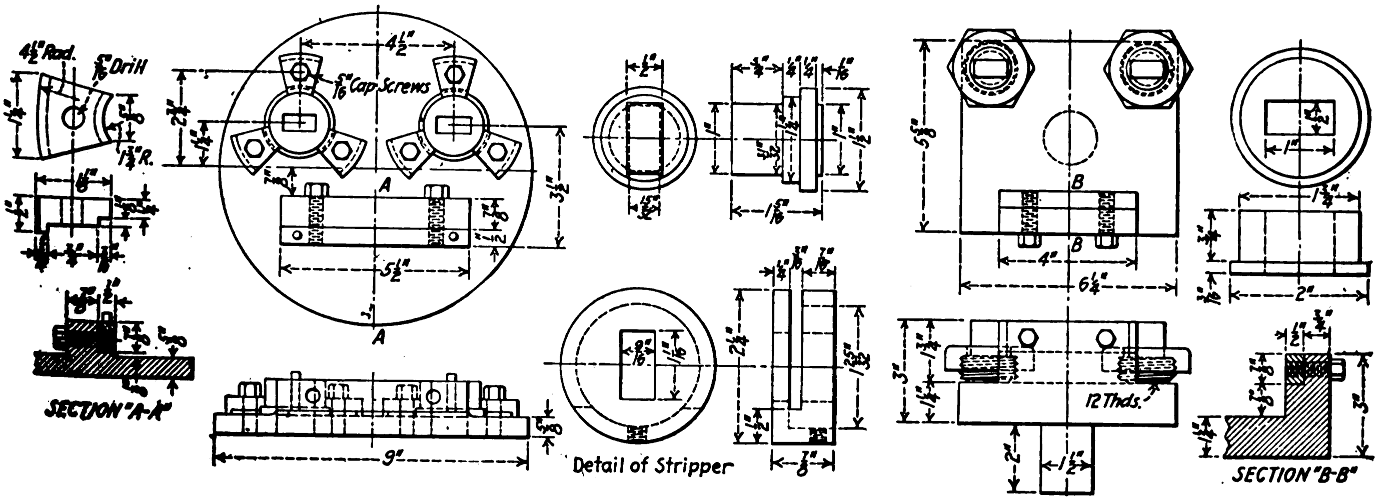
Interior of the Roofing Reclamation Plant

All sheets which are worked over are trimmed to two sizes. One size measures 23½ in. wide by 4 ft. 5½ in. long when finished. These sheets are applied with a 5⅝-in. flashing, 34 sheets being required for a 36-ft. car and 38 for a 40-ft. car. Where the old sheets are split or damaged, farther in from the lower edges, shorter sheets are manufactured. The same width is maintained, but the length is 4 ft. 3½ in. A flashing 7⅝ in. wide is used.



Punch for Cutting Holes with Raised Edges

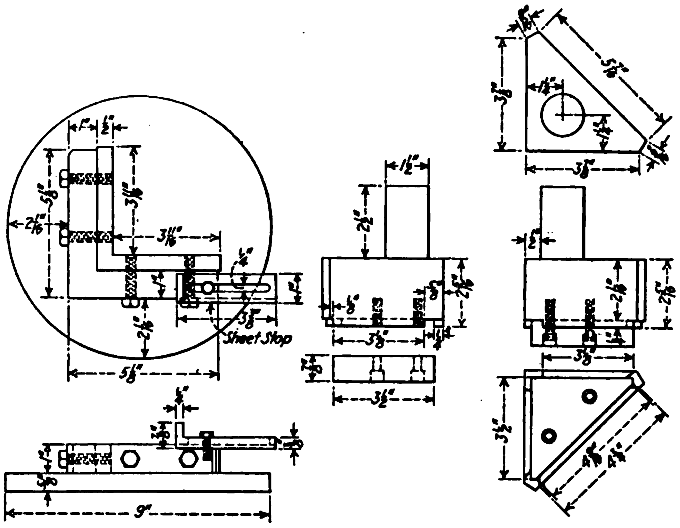
The starting and finishing pieces at the ends of the roof are made in the same manner as the roof sheets. The crease in the top of these pieces is formed in a regular creasing machine, such as is commonly used in a tin shop. These pieces are made nine inches wide and in lengths to suit the two sizes of roof sheets. The long transverse caps are cut from sheets which cannot be reclaimed for further use as full-size roof sheets. They are cut seven inches wide and in two lengths to suit the roof sheets. A special set of dies has been developed for use on the stamping machine to form both the top and bottom corners of these sheets. In the top of these caps is a 7/16-in. hole, the edge of which is raised ⅛ in. above the surface of the sheet. This hole is formed with a hand tool, shown in one of the drawings, which punches the hole and raises the edge in one operation. The purpose of this hole is to sink the ⅜-in. carriage bolts which pass through the center of the roof.



Dies for Notching the Corners and Cutting Saddle Bolt Cover Caps Off of the Strip in One Operation

The short longitudinal ridge caps are also cut from sheets which are otherwise waste material. These caps are cut 5⅝ in. wide by 23⅛ in. long, and a special set of dies is used to form the ends. Each of these caps also has a 7/16-in. hole in the end with the edge raised ⅛ in. above the surface of the sheet. The ends of the cap are turned up ¼ in. in a groove cut in the folding machine for that purpose. Referring to the drawing of the turning machine, it will be seen that two turning rods are provided. That shown at *A* is used for turning the edges of the roof sheets. On account of the long drop and short turn-up on the ridge caps, the turning rod shown at *B* was developed for this operation.

The crown caps which cover the joints of the transverse and longitudinal caps where they come together at the ridge of the car, are cut from the heaviest sheets to measure 8½ in. by 9½ in. and are formed in dies under the air press. These caps also have a 7/16-in. hole with raised edge through the center, which is formed by the punch already referred to.



The Corners of the Flashing Sheets Are Notched with These Dies

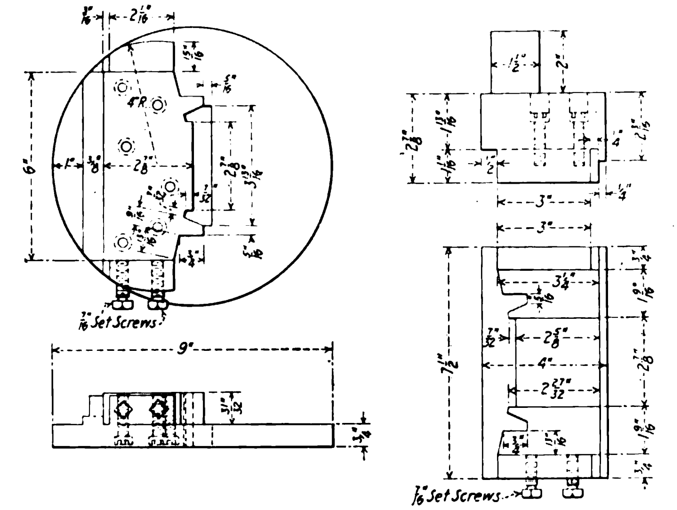
The strips which support the roof sheets are formed with a raised disc in each end, over which sets the similar impression near the upper end of the roof sheet. This impression is formed both in the roof sheets and the supporting strips using the same set of dies in the stamping machine. The supporting strips are 14⅞ in. long by 5 in. wide.

The flashing, which completes the lower edge of the roof, is made in two widths to suit the two sizes of roof sheets.

All corners of the flashing pieces are formed in the stamping machine with one of the special dies and the piece is then folded and locked. The top of the flashing is held down with a cleat made from scrap material, which is folded and locked in the top of the flashing and fastened with two nails to the top of the car. The cleats are spaced so that there will be one under each of the roof sheets.

The saddle cover caps are cut in long strips and run through the stamping machine under a die which cuts out the four corners and cuts off the piece in one operation.

Up to the present time 1,131 of the reclaimed roofs have been applied, some of which have been in service from 19 to 21 months. They have been inspected periodically and so far no complaints of any character have been received. They are at present in as good condition as when they were applied and it is difficult to tell them from new roofs which



Both Ends of the Short Longitudinal Ridge Caps Are Cut with This Pair of Dies

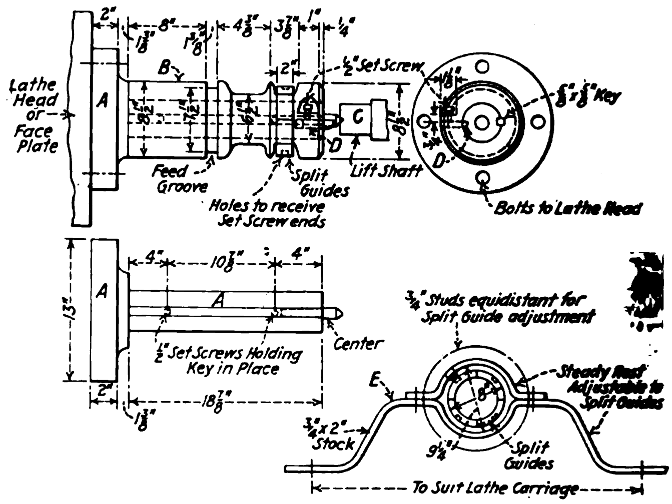
were applied at the same time. It has been found that the paint sticks to the old better than to the new sheets.

When the plant was first put in service each reclaimed roof was produced at a cost of $13.95. This has now been reduced to $10 each, including the scrap value of the reclaimed metal and all overhead and fixed charges. Compared with new roofs, which cost approximately $55 and have a life of about eight years, a considerable saving is thus effected.

Many roofs are removed from cars by the railroad because of leaks caused by one or two nail holes, or because of one or two bad sheets. Practically 90 per cent of the roofs of this kind can be reclaimed and the average for all roofs is 60 per cent. The success of the reclamation work depends upon the maintenance of a rigid inspection of the material which is reclaimed. It would be a very costly practice to manufacture and apply roofs using metal which had unduly deteriorated.

Lathe Attachment for Turning Lift Shaft Ends

SHOPS which do not have lathes large enough to swing lift shafts usually have trouble in re-turning or truing up the worn ends. A number of shops heat the arms of the lift shaft and bend them around so that the worn ends can be turned, or rig up an old lathe for this operation by raising the lathe head and tail stock with iron filling blocks so that the arms will clear the bed, but both of these methods are rather expensive. The lathe attachment here described is easy to make and can be placed on any lathe, providing the



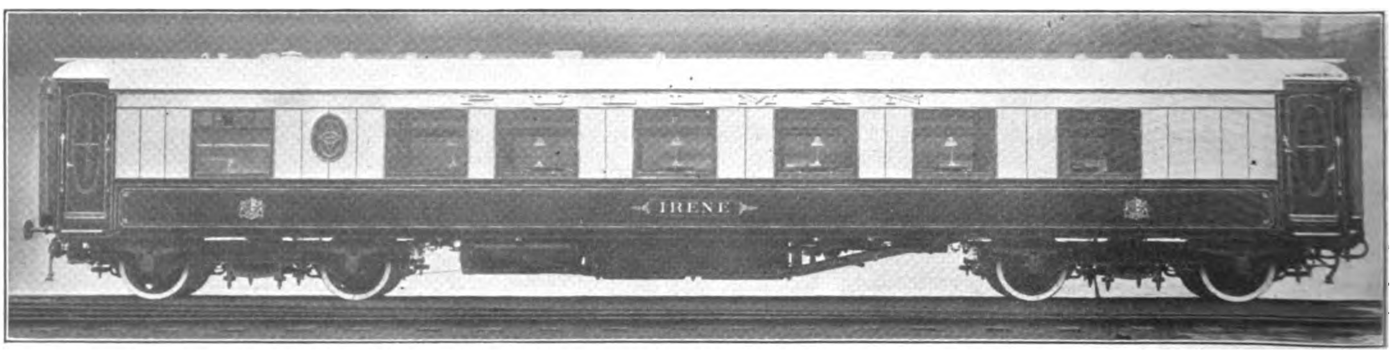
Worn Ends of Lift Shafts Can Be Turned Quickly and Accurately With This Device

bed is long enough to receive the lift shaft. When using it, the lift shaft does not turn and is held in place on the centers with the arms resting against the lathe bed.

The mandrel *A*, which holds the lathe center, is bolted to the face plate and the sleeve *B*, which holds the tool *D*, is keyed to the mandrel but is free to slide longitudinally. The tool is turned about the end of the lift shaft by the rotation of the head and is adjusted to the work and held in place in the sleeve by a set screw. A short piece of 1¼-in. wrought iron is placed in the tool post so as to fit in the feed groove of the sleeve *B*. When the lathe is running and the feed is operating, the sleeve moves with the lathe carriage and the tool *D* is then fed along the worn end of the lift shaft.

In order to hold this attachment more rigidly a steady rest *E* is bolted to the lathe carriage and is adjustable to the split guides which surround the sleeve with a running fit. These split guides should be made of cast iron.

The use of this attachment is a safer method than the old, as a mechanic is not in danger of being caught by the arms of the shaft as they swing around.



First Class Pullman Buffet Car on London and North Eastern Seats Twenty-two Passengers

Improved Shop Operation at Albuquerque, N. M.

New Santa Fe Shops Repaired 302 Locomotives in 1923—Marked Reduction in Man-Hours per Engine

Firing-Up Shed and One End of the Modern Boiler Shop at Albuquerque, N. M.

In 1922 the Atchison, Topeka & Santa Fe completed the construction of new locomotive repair facilities at Albuquerque, N. M., at a cost of about $2,500,000 for the several buildings erected and their complete equipment. As a result, the 1921 output of 56 locomotives was increased to 99 locomotives in 1922 and 302 locomotives in 1923. Of

Fig. 1—Shop Mule Used with Trailers to Deliver Material

the 1923 output, 233 locomotives, including 20 Mallets, were given heavy classified repairs. The marked improvement in operation with the new as compared to the old shop facilities is also shown by the fact that the average man hours per engine for 1924 (based on the first two months) was 17 per cent less than the average man hours in 1923, 22 per cent less than in 1922 and 55 per cent less than in 1921.

New Shops, Efficient Personnel, Effective Schedule

Unquestionably the increased production per man hour at Albuquerque shops, which in many respects represents a remarkable performance, may be attributed to three factors, (1) the large, new, well-lighted, well-equipped shops, (2) the efficient shop personnel in which unusually good feeling and close co-operation has been secured between supervisory forces and shopmen, (3) the simple but effective shop schedule system under an efficiency supervisor who, with a small staff, not only routes locomotives through the shops but is responsible for material ordering and delivery.

Too much stress cannot be placed on the importance of the new shop buildings as affecting output, particularly as the average railroad shop throughout the country is more or less deficient in ventilation, heating and lighting facilities, machine tools and shop equipment. A large proportion of the wall and roof areas of the new Albuquerque shops are of glass construction, arranged to afford light and ventilation to an unusual degree, and the shop is equipped with a full complement of modern shop machinery.

In addition to the new machine and erecting shop building, a modern equipped boiler shop, blacksmith shop, flue shop, paint shop, pattern shop and waste-cleaning shop have been constructed. Maximum flexibility is provided in the erecting shop owing to the provision of a 250-ton crane of adequate capacity to lift the largest locomotives. This crane in conjunction with a transfer table between the boiler and erecting shops facilitates moving locomotives to any erecting shop pit or, in some cases involving heavy boiler work, to the boiler shop. After the repair work is completed locomotives are transferred to the firing-up shed shown in the illustration at the head of this article.

The high quality of workmanship insisted on at Albuquerque and the many labor-saving devices developed in the different shop departments also have had a favorable effect on output, augmented by the fine spirit of co-operation, encouraged and developed between the foremen and shop employees. The humblest employee of the shop who may have a grievance always finds an open door to the office of D. E. Barton, shop superintendent, or J. R. Leverage, assistant

shop superintendent, who is immediately in charge of shop operations.

The evident desire of essentially all Santa Fe employees at Albuquerque to pull together for the good of the shop and the railroad is no doubt fostered by the so-called shop council meetings which are held every second Thursday and which can be attended by any employee of Albuquerque shops. There is no class distinction at these meetings, the voice of the machine shop sweeper having just as much weight as that of his foreman. Matters of shop welfare are discussed at these meetings and the various suggestions developed have been largely instrumental in creating working conditions under which the shopmen as a whole are not only able but willing to do their best, to the end that Albuquerque shop may make as good if not a better showing than any other shop on the Santa Fe system.

In addition to the council meetings, 15-minute noon meetings are held at the shop, the Monday meeting of each week being devoted to safety, the Tuesday meeting to topics of interest to the shop crafts and organizations and the Thursday meeting to general topics such as railway economics, freight rates and their relation to employees' wages, methods of eliminating waste, time, effort and material in shop operation, etc. The interest of the men and the attitude of the management towards these meetings is indicated by the fact that when the speaker has something to say which is of actual importance and benefit to the men he is allowed to conclude his remarks irrespective of the blowing of the whistle.

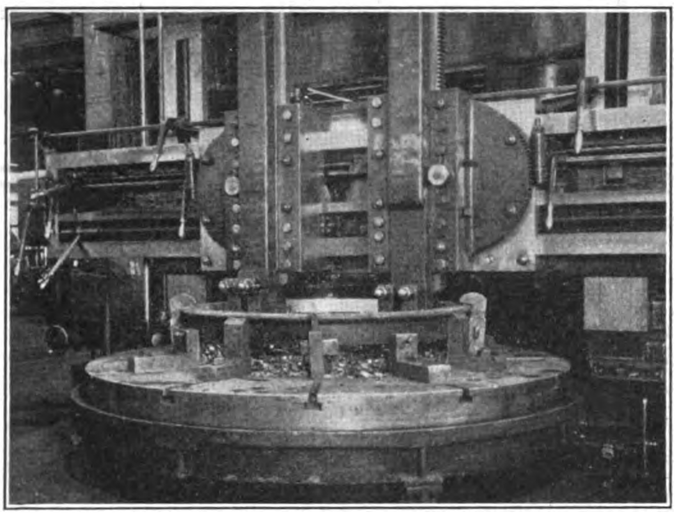


Fig. 2—Powerful Holding Fixtures Are Required with Modern Machine Tools

Major Features of Shop Schedule System

It was realized that in order to secure a desirable shop output some effective method would have to be developed for routing or scheduling locomotives through the shop and yet the management wished to avoid a cumbersome organization which might grow to such a point that the schedule detail would form an appreciable part of the actual work itself. As a result, the operations of analyzing work reports, ordering material, and scheduling locomotive parts through the shop were arranged to be handled by a production department consisting of an efficiency supervisor and two checkers.

Effective scheduling or routing of the work is rendered difficult without a correct and complete work report which in this case is sent to the shop by the division mechanical officers at least 90 days in advance of the date of shopping. On the arrival of this work report it is analyzed by the production department, both as to the operations to be performed and material required and the proper orders given to the store department to provide the necessary items not carried in current stock. Where new items which are authorized for that class of locomotives are not called for on the work report, the attention of division officers in charge of the locomotive is called to this fact and proper authority requested to apply them.

On the arrival of the locomotive at the shop it is placed on the hospital track and held there until ordered into the shop on a schedule which takes account of the proper balancing of the shop in connection with the power ready to leave and the power remaining under repairs. This schedule is, however, flexible enough to take care of emergency cases such as wrecked locomotives, or the temporary heavy requirements of some division for a certain class of power. These emergency requirements must be taken care of promptly.

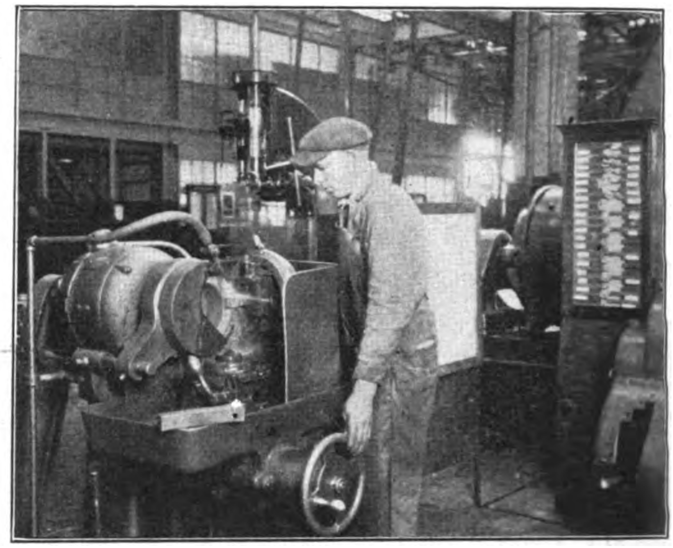


Fig. 3—Gisholt Tool Grinder Used for Sharpening Standard Lathe, Planer and Shaper Tools

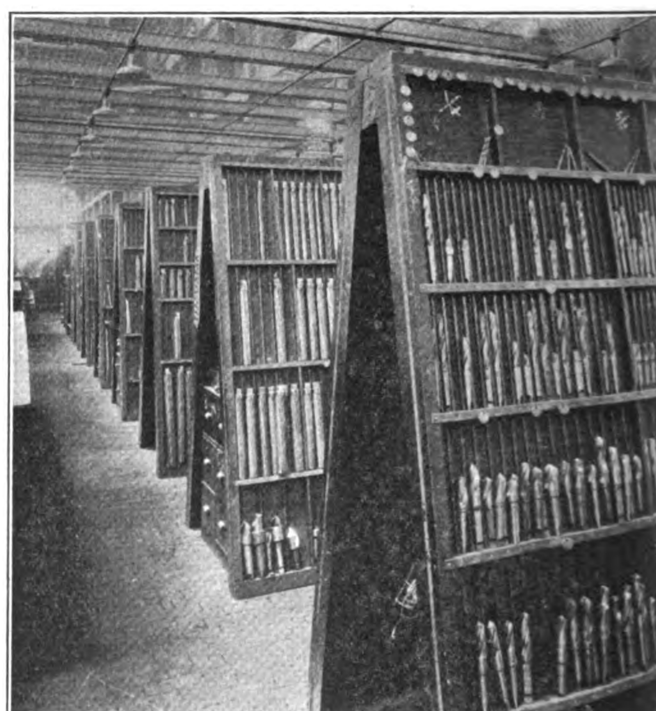


Fig. 4—The Distributing Toolroom, Located in the Center of the Locomotive Shop

When a locomotive is ordered into the shop and is placed

on the stripping track, complete copies of the work reports are given to all departments, in order that all concerned may be thoroughly familiar with the work to be done, and particularly with changes which have been ordered made in former standards.

The locomotive is inspected while on the hospital track and during the stripping process in order that all items of work that may have been overlooked by division officers sending the locomotive to the shop may be properly noted and taken care of. Also at this time all items of additions and betterments which are authorized for that engine and have not yet been applied are noted.

The inspection report is then sent to all concerned and a copy analyzed by the production department which notes necessary items of material that may not have appeared on the original work report. The addition and betterment report is also distributed, particularly to the timekeeper's department and a copy of A. and B. requirements is posted near the locomotive so that all concerned may know just what items will be applied new at this shopping.

Master Schedule Sheet

At the time the engine is placed on the stripping track it is immediately scheduled on the master schedule sheet (Form A) which is sub-divided into 24 groups of major operations, with the date on which each group of operations should be completed placed at the left of the group. These dates have been determined by analysis of previous repairs of the same class made to the same class of locomotives. For instance, a complete general class three repair for a certain type of locomotive is 28 working days.

If a locomotive arrives on the stripping track on March 1, by referring to slide rule (Form B) the locomotive is seen to be due out on April 2. The schedule supervisor takes the master schedule for that class of locomotive properly filled out to show the number of days allowed for each group of major operations, and places the date that it should be finished to the left of each group. This schedule remains in the production office and is the base on which all further activity in scheduling and checking is built.

Schedule Form C is used by each department or bench

SCHEDULE FOR ROUTING LOCOMOTIVES THROUGH SHOP.

Showing the Various Operations, Classified by Groups, and the Limit of Time Set for Overhauling or Repairing the Parts Included in each Group.

3/1/24
Engine in shop.
Ash pan and other parts removed for unwheeling.
Unwheeled.
All parts removed delivered to respective places.

3/4
Guides, crossheads and pistons removed and delivered.
Piston or slide valves removed and delivered.
Spring rigging removed and delivered.
Front end appliances removed and delivered.

3/4
Steam pipes and pot removed and delivered.
Jacket, lagging, all pipe work, and cab removed and delivered.
Frame and cylinders cleaned for inspection.

3/5
Superheater units removed and delivered.
Boiler, frames and cylinders and other parts inspected for defects.
New cylinder ordered.

3/7
Boiler delivered to boiler shop ready for boiler makers.
Flue beads cut, flues cut loose, and removed and delivered.

3/8
Flue sheets, side sheets, boiler or smoke arch courses and stay bolts inspected and marked for renewing.
Sheets to be renewed, cut with gas.

3/10
Flue sheet rivets cut and removed.
Flue sheets out.
Stay bolts chipped and drilled.
New sheets ordered.
Engine trucks stripped.

3/11
Side sheets, door sheet and throat sheet removed.
Radial stays drilled and chipped.
Old cylinder removed.

3/12
Fire box removed.
Stay bolt burrs or bushings removed from outside wrapper sheets.
Cross-heads, guides and pistons, valve and valve motion, side and main rods inspected and new material ordered.

3/13
Side, crown sheets, side casings, flue sheets, reinforced boiler courses, or patches laid off.
Stay bolts, Radial stays, Tate bolts, and Flexible bolts ordered.
Material ordered for engine trucks.

3/15
Fire box, boiler smoke box and boiler sheets laid off and flanged.
New cylinders laid off and chipped.

3/17
Side, and main rods annealed.
Brake and spring rigging cleaned and annealed and renewals ordered.
Driving boxes machined and grooved for brass liners.

3/18
Cylinders and valve chambers bored and bushed.
Binders, grate rigging and engine truck material forged.
Valve and valve motion parts forged or annealed.

3/19
Frame and cylinders lined and changes made.
Brass liners cast on driving boxes.
Driving wheels and axles machined and tires set.
Crank pins O. K.
Cross-heads, brass lined and babbitted.

3/20
Flue sheets O. K. complete.
Stay bolts in and set.
Driving boxes planed.
Guides ground and crossheads machined.
Piston rod fits made.
Spring rigging overhauled.
Studs in fire box and boiler O. K.
Eccentric key ways cut, and eccentrics and straps up.
Tank stripped.
Dry pipe and steam pipes tested at bench.

3/24
Back valve heads ground.
Dry pipe ground and bolted to flue sheets.
Back cylinder heads ground and up.
Reverse rigging overhauled complete.
Air pump and brake valves overhauled.
Flues in complete O. K.
Boiler and fire box O. K. ready for test
Tank up.
Motion work machined.

3/25
Boiler mounting applied.
Driving boxes fit to journals.
Shoes and wedges laid off.
Spring rigging up.
Guides and crossheads ready to line.
Brake cylinders up.
Engine trucks overhauled.
Running and cab board brackets lined.
Valve gear, rocker boxes, and reverse gear in place, reamed and bolted.
Truck overhauled, truck boxes fit.
Boiler tested.

3/26
Engine wheeled.
Valves in.
Motion work up.
Main rods done complete.
Shoes and wedges up and trammed O. K.
Steam pipe casings laid off and drilled.

3/27
Tank cistern and trucks repaired.
Coal pusher repaired.

3/28
Superheater units in.
Valves in complete.
Cab applied.
Air pumps up.

3/29
Cab boards and cab bolted complete.
Steam pipes and pot in and tested O. K.
Boiler lagged.
All motion work up.
Main rods up for valve setting.
Coal pusher applied.

3/31
Jacket applied.
Running board bolted complete.
Ash pan up.
Valves set.
Tank painted.
Front end applied.
Side rods done complete.
Draw bars inspected and annealed or renewals ordered.

4/1
Pistons in.
Brake rigging up.
Grates and grate rigging up.
Main and side rods up.
Pipe work done.
Engine painted.

4/2
Engine trial.

Engine No. —
Date in Shop 3/1/24
Class repairs G 3 – 28 Days
Sched.—Date out 4/2/24
Actual—Date out
Actual—No. days in shop

Cause of delays, if any

Form A—Master Schedule for Routing Locomotives Through the Shop

Month →	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Day →	2	3	4	5	7	8	9	10	11	12	14	15	16	17	18	19	21	22	23	24	25	26	28	29	30	31	1	2	4	5	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	1	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	20	21	22	24	25	26	27	28	29	31
of the	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	←--Slider											
Month →	1	2	3	5	7	8	9	10	11	12	14	15	16	17	18	19	21	22	23	24	25	26	28	29	30	31	1	2	4	5	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	2	3	4	5	6	8	9	10	11	12	13	15	16	17	18	19	20	22	23	24	25	26	27	29	30
Month →	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Form B—Part of a 28-In. Schedule Slide Rule Showing Dates for the Entire Year—65 Days on the Slider

gang, one copy of which is kept hanging on the wall and a second copy carried by the checker. This form is also filled in from the master schedule and the date under each heading shows when the operation covered by that heading should be finished. In checking the work done, the actual date finished is shown in the proper column at the right under the tion of the report is handed daily to the foreman who is delaying the game.

Schedule Form E is the "Master Progress Chart," made new monthly on a sheet of tracing cloth and showing every major operation on locomotives going through the shop. The usual information as to locomotive number, class of repairs

A. T. & S. F.
ALBUQUERQUE
PROGRESS

Upper Date Denotes Schedule Date Due
One Tick ✓ Denotes 1/4 Done
Two Ticks ✓✓ Denotes 1/2 Done
Three Ticks ✓✓✓ Denotes 3/4 Done
Lower Date Denotes Date Work was Completed

	Engine Number	Date in Shop	Class of Repairs	Division From
	8826	2-26-24	G	Ag.
New Cylinders	8814	3-20-24	G-3	Pan.H.
New Cylinders	7313	3-24-24	X-1	Plains

STRIPPING GANG

All Parts Removed and Wheels Out	Ash Pan and Grates Removed	Guides, Pistons, Valves and Spring Rigging Removed	Front End Removed	Steam Pipes, Pit, Lagging and Cab Removed	Frame and Cylinders Cleaned	Superheater Units Out	Maximum Delay
1	1	2	2	3	3	4	
2-27 / [illegible]	2-27 / [illegible]	2-28 / [illegible]	2-28 / [illegible]	2-28 / [illegible]	2-28 / [illegible]	2-29 / [illegible]	5
3-21 / 3-18	3-21 / 3-20	3-24 / 3-20	3-24 / 3-17	3-24 / 3-14	3-24 / 3-20	3-25 / 3-20	2
3-25 / 3-26	3-25	3-26 / 3-26	3-26	3-27	3-27	3-28	

MACHINE SHOP

Engine Number	Crosshead, Valve and Piston Material Inspected and New Ordered	Main and Side Rod Material Inspected and New Ordered	Valve and Reverse Motion Material Inspected and New Ordered	Wheels, Axles and Crank Pins O.K.	Eccentrics or Eccentric Cranks O.K.	Guides, Crossheads and Pistons O.K.	Reverse Rigging O.K., Complete	Air Pump and Brake Valves O.K.	Motion Work O.K., Complete	Valves O.K., Complete	Driving Boxes O.K., and Fit	Main and Side Rods O.K., Complete	Maximum Delay
	9	9	9	14	14	15	16	16	16	17	17	20	
8826	3-11 / 3-4	3-11 / 3-4	3-11 / 3-14	3-19 / 3-6	3-19 / 3-19	3-20 / 3-20	3-26 / 2-29	3-26 / 0	3-26 / 3-6	3-27 / 3-11	3-27 / 3-5	4-1 / 3-10	3
8814	4-3 / 4-3	4-3 / 4-3	4-3 / 4-3	4-11	4-11	4-14	4-18	4-18	4-18	4-21	4-21	4-26	
7313	4-10	4-10	4-10	4-21	4-21	4-23	4-29	4-29	4-29	4-30	4-30	5-5	

BOILER SHOP

Engine Number	Boiler Inspected	Flues Out	Sheets Out and New Ordered	Flue Sheets Out	Staybolts and Radials Out and New Ordered	Firebox Removed	Sheets Laid Off and Flanged	Flue Sheets O.K.	Staybolts in and set	Flues in Boiler ready for Test	Ash Pan Up	Grates and Rigging Up	Front End Applied	Maximum Delay
	4	5	6	7	8	9	11	15	15	16	22	23	23	
8826	3-29 / [illegible]	3-4 / 3-6	3-5 / 3-7	3-7 / 0	3-10 / 3-14	3-11 / 0	3-14 / 3-18	3-20 / 0	3-20 / 3-20	3-26 / 3-26	4-3 / 4-3	4-3 / 4-4	4-4 / 4-4	4
8814	3-28 / 3-21	3-27	3-28	4-1	4-2	4-3	4-8	4-14	4-14	4-18	4-28	4-29	4-29	
7313	3-28	4-1	4-2	4-4	4-8	4-10	4-16	4-25	4-25	4-29	5-8	5-9	5-9	

TANK SHOP

Engine Number	Tank Stripped Complete	Cistern, Trucks, Coal Passer O.K.	Frames and Braces O.K.	Sills, Floor and Draft Gear O.K. Tank Tested	Tank Painted	Maximum Delay
	15	19	20	21	22	
8826	3-20 / 3-11	3-31 / 3-17	4-1 / 3-17	4-2 / 3-18	4-3 / [illegible]	9
8814	4-14	4-25	4-24	4-25	4-26	
7313	4-23	5-2	5-3	5-6	5-6	

Form E—Master Progress Chart Made New Each

heading "Remarks." This form shows at a glance the condition of the work in that gang for each locomotive.

A tickler in the form of a small book is kept by the checker. It contains the working days of the month, in consecutive order, with a page for each date. From the master schedule for each locomotive the "operation group" is posted together with the engine number on the proper page. This is used for the convenience of the checker so that he can tell at a glance each morning just which operation on every locomotive in the shop is due that day. For instance, on the locomotive previously noted on the schedule on March 26 his tickler

and division from which a locomotive comes is shown in the columns on the left margin of the form. Under each major operation and opposite the engine number there is a square containing at the top the schedule date on which that operation is due.

This is where the final report of the checker appears daily. After a complete check of the shop is made, the checker enters in each square on this chart with drawing ink the condition of that operation on that day. If the operation is one quarter done he enters a check mark; on the date when it is half done he places a second check; when three quarters done, a third

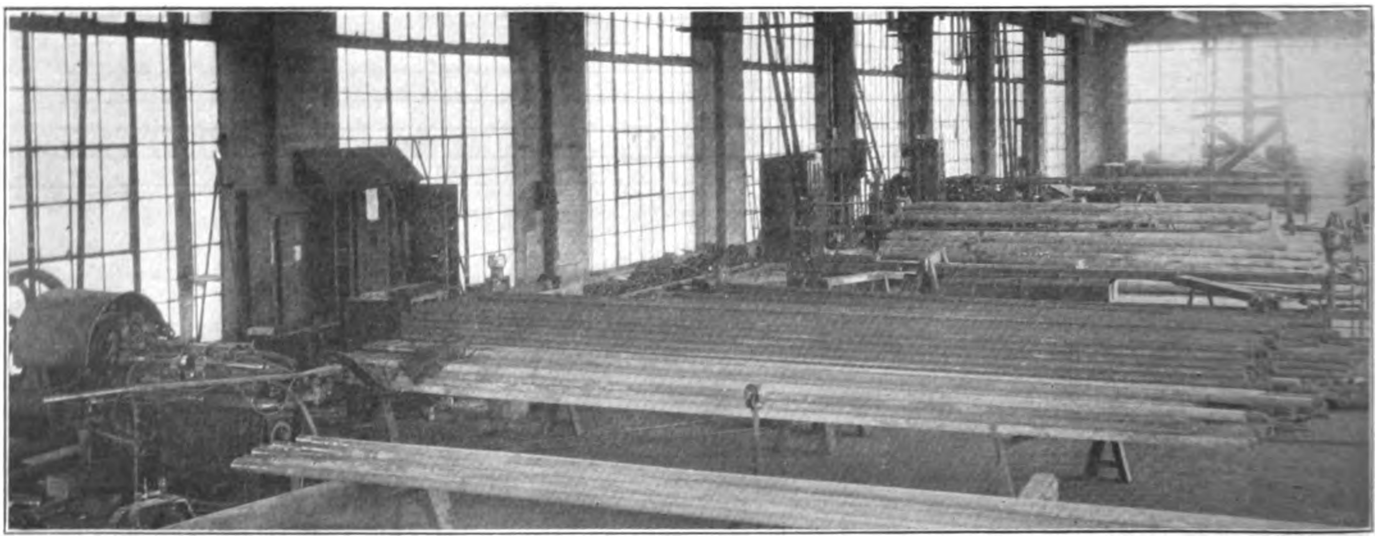


Fig. 5—General View of Well-Organized Flue Shop with Machines Arranged to Prevent Excessive Handling

would show on the page for that date, after the locomotive number, group No. 26, denoting that all items under that group No. 26 must be finished that day.

Schedule Form D is a sample typewritten delay list (in this case for the boiler shop) which is made up daily showing the exact items which are behind the schedule under the heading of the individual foremen. A copy of this goes to the shop officers and also one copy is cut up and his por-

check; and when the operation is completed, that date is shown. In the example illustrated the operation was completed one day ahead of schedule.

This chart is blueprinted daily and in addition to being placed in the offices of the shop officers, copies are hung at various points throughout the shop so that all may have a thorough grasp of the exact condition of each operation each day. There is a heading at the end of each department line

on the chart marked "Maximum Delay" and in this square is shown the exact number of days late on the operation in that department which was delayed the longest. The head of that department is called upon daily to explain why this delay occurred. In other words, each foreman is held responsible for his own delays and must show daily what

The production department, under the direction of the efficiency supervisor, has assumed control of material and its handling. All major items of material are ordered delivered to the shop at the time the locomotive arrives on the stripping track and is inspected. However, there are numbers of small items required by each department in addition

RY. CO.
LOCO. SHOPS
CHART
.....1924

Engine Number	Frames of Cylinders Inspected	Engine Trucks Stripped	Old Cylinders Off and New Ordered	Truck Material Inspected, New Ordered	New Cylinders Laid Off and Chipped	Brake and Spring Rigging Inspected and New Ordered	Cylinder and Valve Chambers Bored and Bushed	Frame and Cylinders Lined	Spring Rigging Overhauled	Studs in Boiler and Firebox O.K.	Eccentrics and Straps Up	Dry Pipe Ground and Bolted	Boiler Mountings Applied	Shoes and Wedges Laid Off	Spring Rigging and Brake Cyls. Up	Engine Trucks Complete	Running and Cab Brackets Lined	Valve and Reverse Gear in Place Reamed and Bolted
ERECTING FLOOR																		
	4	7	8	10	11	12	13	14	15	15	15	16	17	17	17	17	17	17
8826	2-29 2-27	3-7 3-3	3-10 3-10	3-12 3-3	3-14 3-14	3-17 2-29	3-18 3-6	3-19 3-19	3-20 3-3	3-20 3-14	3-20 3-10	3-26 3-6	3-27 3-27	3-27 3-28	3-27 3-4	3-27 3-4	3-27 3-27	3-27 3-7
8814	3-25 3-24	4-1 3-25	4-2 0	4-4	4-8 0	4-9	4-10	4-11	4-14	4-14	4-14	4-18 0	4-21	4-21	4-21	4-21	4-21	4-21
7313	3-28	4-4	4-8	4-14	4-16	4-17	4-18 0	4-21	4-25	4-25	4-25	4-29	4-30	4-30	4-30	4-30	4-30	4-30

Engine Number	Boiler Tested	Engine Wheeled, Shoes, Wedges and Binders Up	Superheater Units In	Valves In Complete	Air Pumps Up	Cab and Boards Bolted Complete	Steam Pipes and Pot In and Tested, O.K.	Lagging Applied	Motion Work and Main Rods Up for Valve Setting	Jacket Applied	Running Boards Bolted	Brake Rigging O.K. Complete	Valves Set	Pistons In	Brake Rigging Up	Main and Side Rods Up Complete	Pipe Work O.K., Complete	Engine on Trial	Turned Over for Service	Maximum Delay	Total Days in Shop	Total Days Late	Maximum Delay to Engine in Shop	Remarks
ERECTING FLOOR																								
	17	18	20	20	20	21	21	21	21	22	22	22	22	23	23	23	23	24						
8826	3-27 3-27	3-29 3-7	4-1 4-1	4-1 4-1	4-1 4-1	4-2 4-9	4-2 3-12	4-2 4-12	4-2 3-13	4-3 4-13	4-3 4-3	4-3 3-4	4-3 3-14	4-4 3-20	4-4 3-7	4-4 4-6	4-4 4-15	4-7 4-15	4-16	10	43	8	10 Days Delay to Erecting Floor	
8814	4-21	4-22	4-24	4-24	4-24	4-25	4-25	4-25	4-25	4-28	4-28	4-28	4-29	4-29	4-29	4-29	4-29	4-30						
7313	4-30	5-1	5-5	5-5	5-5	5-6	5-6	5-6	5-6	5-8	5-8	5-8	5-8	5-9	5-9	5-9	5-9	5-12						

Month and Showing Each Major Operation

he is doing to avoid them. This chart also shows the total number of days the locomotive was held in the shop and the department which delayed it the longest.

Form F Stimulates Keen Departmental Rivalry

The master progress chart is as flexible as is required and gives a close line on the weak and strong departments of the shop by reason of the minute recording of maximum delays to each locomotive in each department. From this information Form F can be readily filled in, showing a monthly analysis of the shop output and serving as a definite guide in balancing man-power in the shop. A complete summarization of the work of each department is afforded; also any special trouble that may have been encountered in handling the work on locomotives for that month, such as inability to get necessary material, etc. This form has

SPRING GANG								
ENG. NO.	Spring Rigging at Smith Shop	Spring Rigging Machined	Spring Rigging Assembled	Spring Rigging Up	REMARKS			
—	3/17/24	3/19/24	3/20/24	3/25/24				

Form C—Typical Department Schedule Sheet

created a keen rivalry between departments and while it has been in effect only a few months has caused the average delay per engine to drop 40 per cent.

The schedule is intentionally made short with the idea of setting a mark to shoot at and thus keep the various shop departments keyed up to a point where the production will approach as nearly as possible the mark set. A shop schedule which could be met by all departments would be practically valueless. All clerical work necessary on the schedule has been absorbed by the previous force in connection with other work; the supervision of material has been absorbed by the efficiency supervisor and the only additions to the former force strictly assigned to this work are two checkers, one for the machine and erecting work and one for boiler work.

and these are procured by foremen making out a work slip which is used as an order on the sub-store room located in the center of the machine shop. This sub-store carries in stock at all times over 1,500 different small items.

The foremen's work order is at once filled from this stock,

BOILER SHOP DELAY LIST

Albuquerque, N. M., Mar. 19, 1924

BOILER GANG NO. 1 — DAYS DELAYED

3252 Back flue sheet patch not removed 3-17..............2
2010 Flues not removed 3-17. Waiting for removal of units..2
3810 Staybolts not applied complete 3-19.................
1158 Flues not removed 3-18 Wt. on stripping gang........1

BOILER GANG NO. 2

3808 Radials not applied complete 3-14....................3
3808 Boiler and firebox not O.K. for test 3-14..............3
3255 Boiler and firebox not O.K. for test 3-18...........1
3322 Flues not removed 3-18..................................1

ASHPAN AND FRONT END GANG

1699 Grates and rigging not up 3-18........................1
3730 Front end not applied 3-13..............................4
5808 Front end not applied Wt. on test 3-14..............3
3808 Ashpan not applied 3-14................................3
3730 Grates and rigging not applied Wt. on test 3-14.....3
3808 Grates and rigging not applied Wt. on test 3-14.....3

STRIPPING GANG

1158 Engine not unwheeled 3-17..............................2
1158 Guides, crossheads and pistons not removed 3-18.....1
1158 Valves not removed 3-18...............................1
1158 Spring rigging not removed 3-18......................1
1356 Ashpan and grates not removed 3-18..................1
814 Ashpan and grates not removed 3-14...................3
814 Guides, crossheads and pistons not removed 3-17.....2
814 Valves not removed 3-17.................................2
1366 Units not removed 3-17..................................2
814 Units not removed 3-17...................................2
3303 Remove R. L. P. Cyl. 3-18...............................1
914 Engine not unwheeled 3-19..............................

PAINT GANG

3730 Tank not painted complete 3-13........................4

BOILER GANG NO. 3

1113 Staybolts not applied complete 3-13...................4
1113 Flues not applied complete 3-19......................
1113 Boiler and firebox not O.K. for test 3-19...........

Form D—Typical Delay List Issued to Each Department

and a requisition passed to the store department charging these items to the locomotive on which used, and this requisition in turn is filled by the store department and the sub-store stock thereby replenished. Any other items which may be required and which are not in sub-store stock, are secured on a requisition issued to the store department and delivered

to the shop hourly by the shop mule illustrated in Fig. 1. If the material is not in store stock, the requisition comes to the material clerk as a turn down and the store department is immediately instructed to get this material on hand from the central store at Topeka, Kan.

When such a turn down occurs, the foreman in charge of the operation involved receives Form G which in addition to advising him that the item is not forthcoming, tells him under the heading, "What Effort is Being Made to Get This Material" just what has been done in the matter. This is a time saver as the foreman knows that the article is not at once available and can govern himself accordingly.

The checkers then follow up these turn downs and as soon as material is received at the local store, see that it is brought to the shop at once. The delay from this cause is noted on the delay sheets and progress chart. A large amount of former delays on this account have of course been eliminated by analyzing the work report before the locomotive arrives and inspection reports after arrival. A reduction of 75 per cent in the number of material turn downs has been made in the past year.

Trucking Service Saves Time and Labor

A trucking service has been installed using the Shop Mule, shown in Fig. 1, and trailers. This service is on a schedule run to all parts of the shop over a regular route and picks up material at any station, carrying it to any other station. Each column in the building has a station number and it is only necessary for foremen to mark the station to which material or locomotive parts are to go to have it delivered to the proper point. One complete trip every hour is made to all parts of the shop and it is found that this works very satisfactorily, practically eliminating hand trucking, giving maximum efficiency in the use of the shop mule and cutting necessary supervision over the trucking service to a minimum.

Shop orders are issued by the store department and sent to the production department. The material clerk at once orders the necessary parts to the shop and has them sent to the correct machine. A copy of the shop order is given to the gang foreman in charge who returns it to the material clerk when the work is finished. Where work is necessary by some other department, the material clerk issues an order for the delivery of this material to the proper department and sends with it a copy of the shop order as before. When these orders are finished they are returned to the storehouse and the shop order is closed.

Speed and Feed Charts on Each Machine Tool

One of the reasons for the good results obtained at Albuquerque has been the attention given to the machine department in order to bring its operation to as high a point of efficiency as possible. With the exception of three tools, namely, a lathe, planer and shaper, the work on all of the rest of the machines is assigned and charts posted on the side of each machine show the kind of work assigned to that machine and the exact feeds and speeds to be used. These charts have been worked out by tests for each machine and represent the feeds and speeds at which maximum production over a period of time can be obtained.

The allocation of certain specific work to certain machines results in several important advantages. In the first place, the erecting shop men know where to leave and find particular locomotive parts without the lost time involved in hunting up foremen. Machine operators become expert on specialized work. There is less loss of time in changing work and tool set-ups. Moreover, the work of the various machines is balanced and the machines are kept speeded up to a higher point of production than would otherwise be possible.

One machine demonstrator or checker is constantly employed seeing that these feed and speed charts are observed. This man reports directly to the assistant shop superintendent. As a rule no difficulty has been experienced in getting the machine operators to put their speeds and feeds up to

A. T. & S. F. RY. CO.
ANALYSIS OF OUTPUT
MONTH OF......1924
ALBUQUEQUE SHOPS

Eng. No.	Schld. Time	Class Repairs	Schld. Date Out	Actual Date Out	Shop Time	MAXIMUM DELAY TO ENGINE IN							Ahead or Behind Schld.	No. of Days Ahead or Behind	Remarks
						Strip Gang	Smith Shop	Mach. Shop	Boiler Shop	Tank Shop	Erect. Floor	Special Delay			

Form F—Showing Delays in Each Main Locomotive Shop Department

Table I—Typical Examples of Feed and Speed Charts Mounted on All Machines.

Boring Mill No. 5,247

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Eccentric cams	50	1/16	1/4
Eccentric straps	84–180	.083 to .068	3/16 to 1/16
Brass liners	100–200	1/10 to 1/30	1/4 to 1/16
Walschaert link frames	100	1/32	1/16
Exhaust pot	30	1/16	1/2
Stand pipe	25	1/32	1/8
Throttle box	30	1/16	3/32
Short smoke stack	50	1/32	1/4
Cylinder heads	60	1/30	1/8
Bull rings	30	.131	1/4
Dome caps	100	.068	1/8
Center castings	55	1/16	1/8

Slotter No. 3,010

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Crosshead (clearance)	25	1/16	3/16
Crossheads (fits)	25	1/16	3/16
Truck boxes	25	1/32	1/4
Driving box brass	40	1/16	5/8

Planer No. 5,237

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Links	30	1/16	1/8
Link blocks	30	1/16	1/8
Plates	35	1/16	1/8
Reverse levers	30	1/32	1/8
Quadrant	35	1/16	1/8
Eccentric cranks	25	1/16	1/4

Lathe No. 2,955

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Piston rods	75	1/16	1/8
Piston valve turn	50	1/16	1/4
Piston valve, grooved	50	1/16	1/16
Crosshead fits	75	1/16	1/8
Spider fit	75	1/16	1/8

Wheel Lathe No. 3,041

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Driving wheels, 48, 50, 56, 60, 72 in.	13 to 15	7/32	1/4 to 3/8

Turret Lathe No. 5,779

Item	Speed, r. p. m.	Feed, in.	Cut, in.
Equalizer pins	100	.109	1/2
Grease cups	100	.153	1/16
Crosshead collar	38	.109	1/2
Plugs	136	.109	1/4

Slotter No. 5,238

Item	Speed, ft. per min.	Feed, in.	Cut, in.
Links	30	1/16	1/8
Saddles	30	1/16	1/8
Blocks	30	1/16	1/8
Eccentric keyways	19	1/16	5/8
Eccentric cranks	25	1/16	1/4

the point called for, but whenever a difference of opinion arises between the machine operator and the checker, the latter's word goes and the machine must be speeded up or down as he directs. This checker has become so familiar with the various shop machines that he can tell with a fair degree of accuracy by glancing at the position of the operating handles in passing whether or not the machines are working at the correct speeds. Typical examples of charts

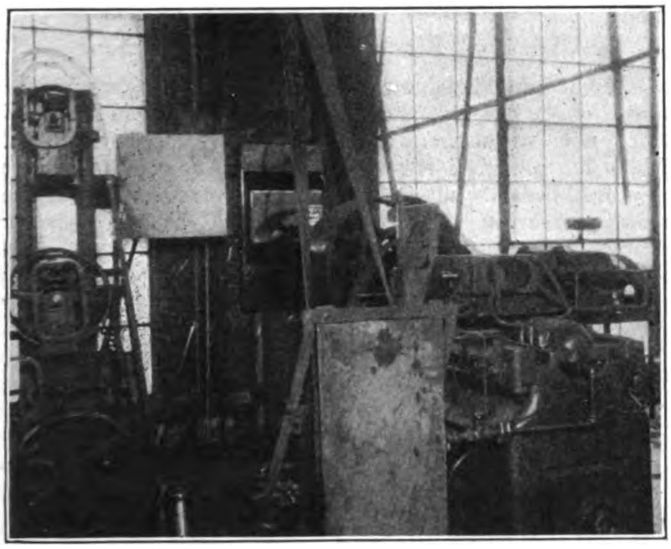


Fig. 6—Close-Up of Thompson Superheater Flue Electric Welding Machine

posted on each machine showing the class of work to be handled by each machine, the cutting feeds and speeds are shown in Table I.

The output of the machine shop has also been greatly increased by labor-saving jigs and fixtures which will be described in a subsequent issue of the *Railway Mechanical Engineer* as space is not available in this article. As an example of the powerful work holding fixtures required by the cutting feeds and speeds used on modern machine tools, attention is called to Fig. 2 in which a 56-in. steel locomotive driving tire is being bored. The nature of the holding fixtures is readily apparent from the illustration. The tire is supported on four right-angle brackets resting against the tire flange. Four additional right-angle brackets firmly bolted to the boring mill bed are provided with set screws for centering the tire, which is held rigidly against upward

DATE..............................
FOREMAN..........................
Your order on Engine..................................
FOR...
....
....
has been turned down by the Store Department (Date)................
What effort is being made to get this material.....................
....
Yours truly,
MATERIAL SUPERVISOR

Form G—Foremen's Information Blank Showing Material Lacking In Store Stock

movement under heavy cutting feeds and speeds by four hooks engaged at one end in the table T-slots and arranged to be tightened by wedges.

Standard Lathe, Planer and Shaper Tools

The efficiency of the machine operations has been further increased by the use of standard carbon and high speed steel cutting tools for the shop machines. These standard tools are made for the system at Topeka shops in accordance with gages which give the proper degree of rake, side slope and clearance angles as described in an article on page 705 of the October, 1923, *Railway Mechanical Engineer*. Properly ground tools assure the removal of metal in a minimum time with the minimum consumption of power and with a more desirable degree of smoothness and accuracy than would be possible when each machine operator grinds tools to suit his individual fancy. In addition, machine tools are operated a larger proportion of the time with a desirable increase in production.

A supply of these standard tools is always kept on hand at Albuquerque shops, ready to be put in service at a moment's notice. All grinding is done by one man on a Gisholt tool grinder shown in Fig. 3, complete instructions for grinding the tools being shown on the chart at the operator's right and a full set of wooden models of standard tools being enclosed in the cabinet mounted on the boring

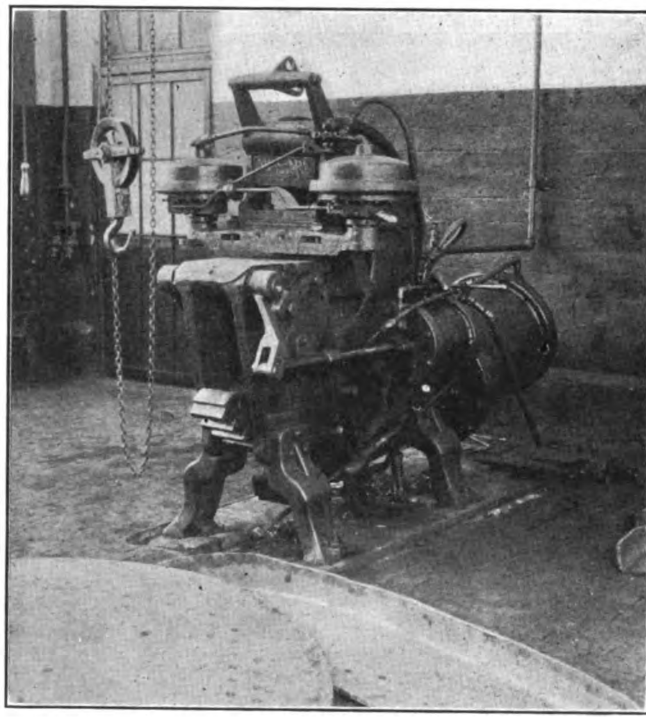


Fig. 7—Boiler Sheets Are Flanged Cold on This McCabe Pneumatic Flanging Machine

mill housing at the right. The tools are gathered from the machine by a tool runner who takes them to the grinder for resharpening, others being furnished to the machine operator in the meantime. Badly worn tools, after being replaced by new ones, are taken to the tool fire in the blacksmith shop in batches twice a day. The tools are re-formed by the blacksmith who also has a set of standard gages to work to, thus eliminating the necessity of removing excessive stock on the first grinding. The tools are then rough ground and afterwards returned to the tool fire to be hardened. Machine operators are not allowed to grind any tools at Albuquerque.

Fig. 4 shows the appearance and equipment of the well-lighted distributing toolroom, located in the center of the locomotive shop. This toolroom is large, with convenient racks for the thousands of small tools required in modern locomotive shop operation and the arrangement of the racks is such that any desired tool can be found quickly. The location of this distributing toolroom between the machine and erecting departments is a desirable feature not found in all railroad shops. It is just as accessible to the erecting shop men as to the machine operators.

Located in the center of the balcony on the south side of the machine shop is the manufacturing toolroom, a very important department of the locomotive repair shop. This department takes care of all repairs to tools such as pneumatic hammers, air guns and jacks and makes general machine repairs. It also has facilities for grinding drills, reamers, taps, dies and special form tools. It makes all inspections of air hoists, cranes, cables, etc., and inspects all shop lockers, drawers and boxes weekly, removing all surplus tools. Worn reamers, staybolt taps and other tools are annealed and worked up into smaller tools and parts for flue expanders, etc. Rivet snaps, cones, and buttonheads are annealed and turned to the next size. Jigs, fixtures and dies used throughout the plant are also made in this department.

Flue Shop Work

Perhaps the most important part of the boiler department work, capable of organization on a production basis, is the welding of tubes and flues, which work is performed at Albuquerque in the north wing of the boiler shop. Two different gangs are employed, one on tubes and the other on flues, the arrangement of the machinery being such that all movements are in a straight line as much as possible, thereby eliminating back movement and excessive handling. A system of tracks leading from the flue rattler and storage shed to all doors of the flue shop eliminates extra handling of flues. Referring to Fig. 5, the equipment for handling the small tubes is shown in the foreground with the larger superheater flue equipment in the background. The welding operations in this shop are done on two Thompson electric welders, a close-up view of the five-inch machine being shown in Fig. 6. The belt sander is shown at the left in this illustration. These electric welding machines operate on 440-volt, 60-cycle alternating current and enable safe ends to be welded on tubes and flues rapidly and with a small percentage of failure. All tubes and flues are tested after being welded to make sure that no defective ones, requiring subsequent removal, are applied to the boiler.

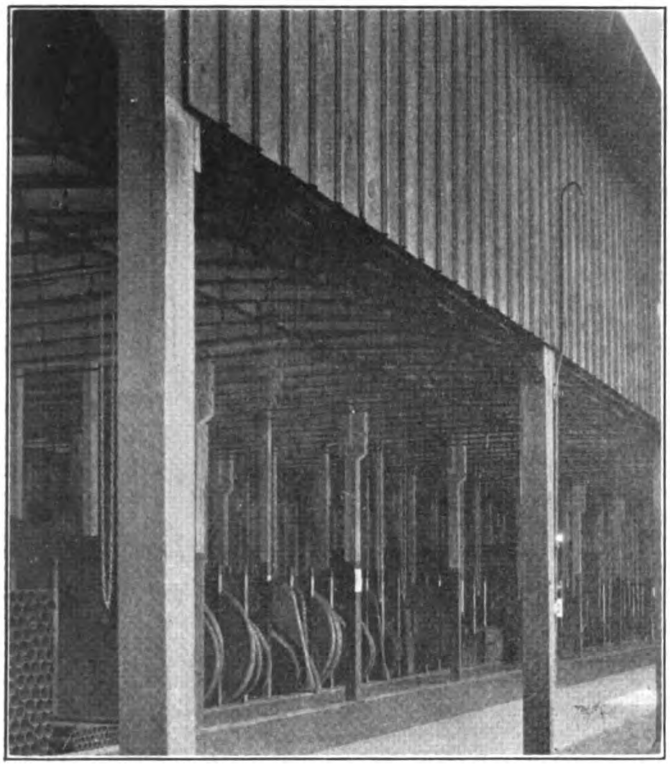


Fig. 8—Storage Shed for Boiler Plates, Tubes and Flues

A large amount of heavy boiler work is done at Albuquerque and in flanging boiler sheets the McCabe pneumatic flanging machine, illustrated in Fig. 7, has proved an important time saver owing to its ability to flange these sheets cold with accuracy and speed.

Adjacent to the boiler shop is an exceptionally well arranged shed for the storage and handling of boiler plate, tubes and flues, shown in Fig. 8. All of this material is under cover and protected from the weather and by means of an overhead conveyor system one or possibly two men can handle the heaviest plates from the storage shed to the boiler shop.

Additional Blacksmith Shop Equipment

The blacksmith department, located north of the machine shop, was recently strengthened by the addition of three new steam hammers of 4,000 lb., 2,000 lb. and 1,000 lb. capacity, respectively. Two new blowers were also installed for supplying air to the forges, which were recently re-arranged back to back so as to conserve floor space. Three oil-burning furnaces are in use at the present time and more will be installed in the near future. Plans are also under way for a complete tool forging and hardening outfit.

Many locomotive forgings are made in the blacksmith shop of scrap staybolts, first cut to a convenient length, then piled in the furnace and heated into a mass, and drawn to 6-in. by 10-in. by 5-ft. slabs or billets. These slabs are later forged into drawbars, binders, equalizers and all other forgings requiring this kind of material. All bolts used on locomotives are forged in special dies. Discarded axles are used for making piston rods, crossheads and knuckle pin forgings. Old driving wheel tires are re-forged into crosshead keys and front end rod key forgings. All radial staybolts used in the boiler department are upset on special machinery and dies in the blacksmith shop.

Important results are expected at Albuquerque through the installation of the De Remer-Blatchford car-bottom furnace illustrated in Fig. 9. It has been observed that frame breakage in modern heavy locomotives can be greatly reduced by periodical annealings of the frames and this annealing is required in the case of rods and other parts of the motion work subjected to similar stresses. The furnace illustrated is wide and long enough to take the largest locomotive frame and while frames would probably not be taken down especially for annealing, whenever they are removed for some other reason, they are annealed in this furnace before reapplication. With the volume of locomotive motion parts passing through Albuquerque shops there is no difficulty in keeping this furnace in continuous eight-hour operation on parts which can be greatly improved by annealing.

The arrangement of the furnace with a counter-weighted door (there is a similar door in the other end) and the simple, fireproof roof, is illustrated. The car bottom is arranged in three sections, or cars, and by means of two partitions either end section or the middle section of the furnace can be operated independently of the other.

Well-Organized Erecting Shop

Special attention at Albuquerque has been given to organize the erecting shop so that the work of removing and reapplying locomotive parts can be handled with the greatest despatch. The erecting floor contains 26 stalls, two being used for stripping and 24 for erecting work. These stalls are divided among three foremen, each having charge of eight locomotives which remain in their respective stalls until the work of erection is completed, unless heavy boiler work is required, in which case they are moved to the boiler shop.

The erecting shop work has been further speeded up by providing four specialized gangs under each erecting shop gang foreman for handling frame and cylinder work, guide, piston and valve work, boiler mounting work and bolt or drilling and reaming work. These gangs are composed of mechanics, helpers and apprentices.

The frame and cylinder gangs do all the work connected with the frames and cylinders, such as lining, fitting up and applying new cylinders, applying frames, frame braces, furnace bearers, deck plates, boiler braces, etc. The guide and valve gangs line and apply the guides, crossheads, pistons, cylinder heads, valve motion, set the valves and apply the rods. The boiler mounting gangs apply and overhaul all boiler mountings, take water levels, apply water columns, front ends, boiler studs, brackets, etc. The drilling and reaming gangs drill out the old bolts, ream all holes and apply the bolts when made.

Besides these gangs there is the engine truck gang that overhauls the engine trucks, and the shoe and wedge gang that fits up the frame binders, fits the shoes and wedges to the frames, lays them off and applies them after the engine is wheeled, each in charge of a lead workman.

The steam pipe and superheater unit gang makes repairs to the steam pipes, throttles, exhaust pipes, superheater headers and units, testing them and applying them. The spring and driving brake rigging gang overhauls all the spring and brake rigging and applies it to the engine.

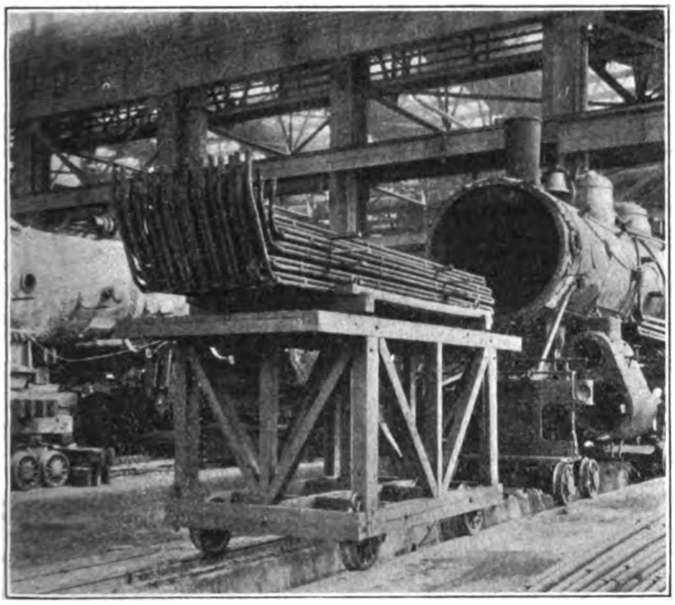


Fig. 11—A Platform Truck Facilitates Removal of Superheater Units

When a locomotive is delivered to a gang foreman he checks the cylinders and valve chambers and has the bushings bored or renewed as necessary. He inspects the frames, which have been cleaned, white-washed and hammered for cracks or other defects and for loose or defective bolts. The bolt gang leader is given a report on these and he lines up his men on the work. If the locomotive requires new frames the boiler is removed, old frames scrapped and new frames which have been assembled by the frame gang brought to the erecting pit and the boiler set in place. The boiler is lined, bolts and braces applied, water level taken and boiler mountings applied. The spring rigging is then applied, the engine wheeled, shoes and wedges applied, guides, pistons and valve motion applied, valves set, rods applied, boiler tested, lagging and jacket and pipe work applied and grates or draft pan applied. The locomotive is finally taken to the firing shed, fired up, tested out and taken on a trial trip by the break-in engineer who makes a report of the defects. These defects are corrected; the locomotive is inspected by the engine inspector and after all defects are corrected the locomotive is turned over for service.

The general erecting foreman assigns the locomotives to the various gangs and has general supervision over all the work. The gang foremen have direct supervision over the work on the locomotives assigned to their respective gangs and over all the men in their gangs. The gang foremen order all material necessary for the repairs to locomotives in their charge.

One of the portable engine lathes used for fitting frame bolts in the erecting shop is shown in Fig. 10. Great attention is paid to the accuracy of these fits and with a capable operator and lathe located close to the engine, it is thought that more satisfactory individual fits of each bolt to its hole can be made rather than to try and make the bolts in quantity to certain standards and then ream the holes to fit the bolts.

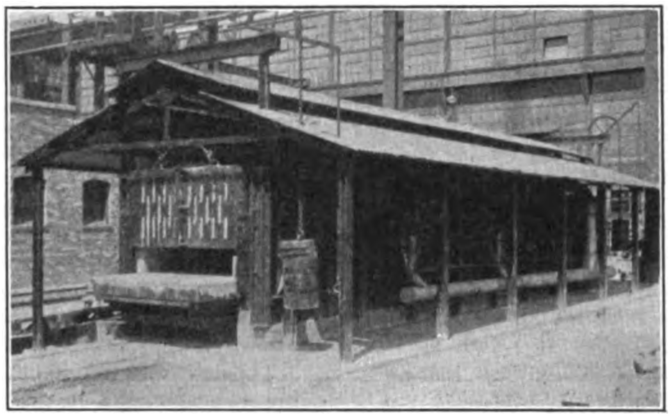


Fig. 9—DeRemer-Blatchford Car Bottom Furnace for Annealing Locomotive Frames

Work benches are placed between pits and also portable vise stands which save many steps otherwise required with vises located at some distance on wall benches. The convenient location of one of these vises is shown at the right in Fig. 10. There are also a number of other devices used on the erecting floor designed to save time and physical effort in carrying on the work. The special platform truck illustrated in Fig. 11 has proved of great value in handling the superheater units into and out of the boiler. The main lower body of the truck which is of substantial construction is mounted on four flanged wheels, enabling it to be pushed to the most desirable distance from the locomotive for easy handling of the units. The truck can also be readily moved about the shop by means of a crane and chain extensions to the four lower eye-bolts. A close examination of the illustration will show that an auxiliary platform is provided on

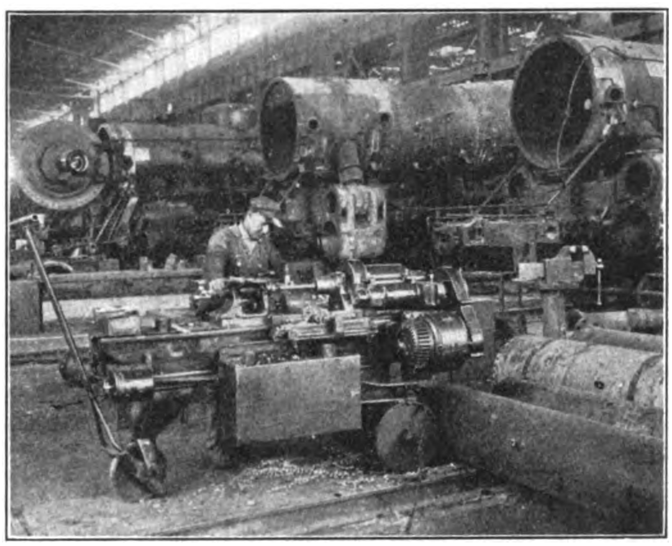


Fig. 10—Portable Engine Lathe Used in Fitting Frame Bolts

top for the receipt of the superheater units. This enables one complete set of units to be picked up by the crane and transferred to the center bay, where they are repaired.

Reduced Power Plant Fuel Consumption

By a systematic study of power plant operation, particularly as relates to the boiler room at Albuquerque some highly satisfactory results have also been obtained in the reduced fuel consumption. The fuel consumption in February was 3.4 per cent less than in January with a still further reduction of 1.4 per cent in March. This economy was effected by increased efficiency of combustion and the reduction of air, steam and power leaks.

In order to make an effective study of boiler operation, nine Bailey flow meters were installed, one on each of the five Stirling 450-hp. boilers and four in the engine room indicating the air, steam and water consumption at the shops, roundhouse and depot. Referring to Fig. 12, the single-hand meter at the left shows the steam flow to the roundhouse in pounds of steam per hour and the double-hand flow meter next to it shows the steam pressure and flow to the depot. If the steam flow to either the roundhouse or depot becomes excessive the steam consuming power and heating units are checked, steam leakage and waste being detected and corrected. The second double-hand flow meter

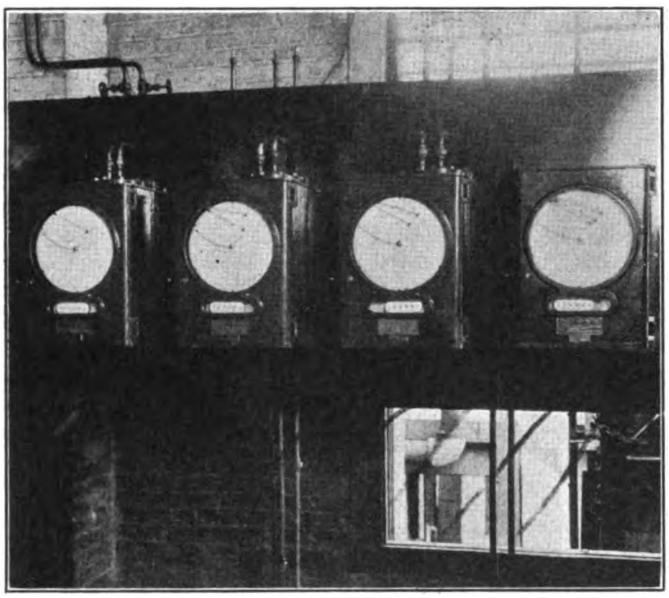


Fig. 12—Four Bailey Flow Meters in the Engine Room

shows the total water in gal. per min. delivered by the pumping engines, one hand indicating the flow and the other the pressure. There are now five hard water wells and three soft water wells at Albuquerque and it is the intention to drill four more hard wells, at which time approximately 35,000,000 gal. of hard water and 40,000,000 gal. of soft water a month will be pumped. The right hand flow meter has three hands, one indicating temperature, one flow in cu. ft. per min. and one pressure. All four meters are provided with integrators, giving the total consumption in 24 hours. Since the installation of these meters many leaks and other wastes have been prevented.

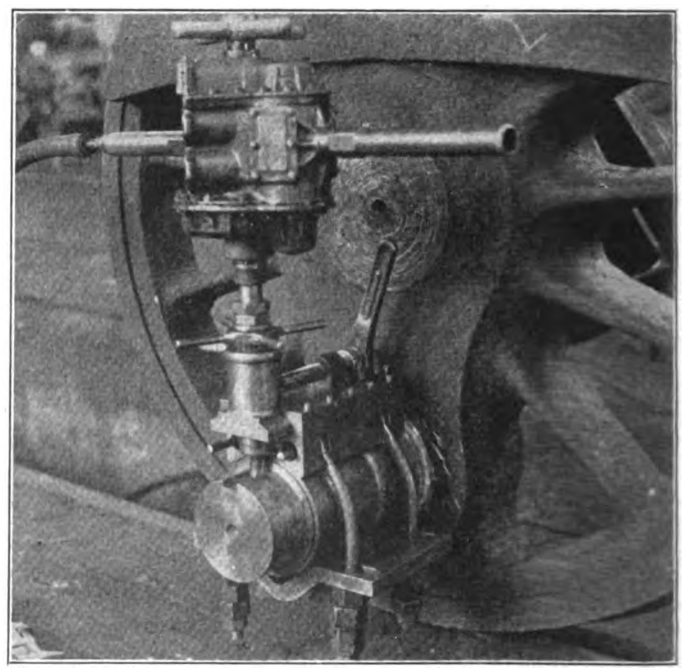
Flow meters connected to the boilers in the boiler room have made possible a more efficient burning of coal, and consequently are largely responsible for the decreased coal consumption. Each of these meters is provided with four pens in as many different colors, the red pen indicating the steam flow; the blue pen, air flow; the green pen, flue gas temperature; the orange pen, degrees of superheat. With the air flow pens properly adjusted for efficient combustion in each boiler the fireman keeps the two flow pens on each boiler together. In other words, when for any reason there is a call for increased output of the boilers the steam flow pens rise. The fireman then allows just enough increased air to flow to the grates, to cause the air flow pens to rise an equal amount. The proper amount of air for efficient combustion is thus provided at all boiler loads without depending on the fireman's judgment.

If for any reason the flue gas pens show an increased temperature, the fireman looks for trouble which may be dirty flues, a broken baffle, etc. It was the practice formerly to blow flues three times a day but by the indications of these pens one blowing in 48 hours was shown to be sufficient and a considerable amount of steam is saved as a result. Similarly any drop in the temperature of the superheat would be instantly noted and the trouble looked for. The proper setting of the air flow pens was made by the use of a CO_2 recorder, after going over the entire setting of the boilers, checking for leaks with a torch, filling cracks with plastic cement and thus preventing an excessive supply of air. The percentage of CO_2 in the flue gas was increased from about 8 per cent to an average of 13 per cent.

A Portable Key Seat Milling Machine

By E. A. Murray
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

THE machine shown in the illustration will be found to be well adapted to the milling of keyways in crank pins or axles. Sufficient clearance has been provided for the air motor drive so that keyways may be milled in crank pins regardless of the position of the driving wheel. The device consists of a slide base which is clamped to the axle or crank pin by means of four hinged bolts and a clamp plate.



A Keyway Miller for Crank Pins and Axles

The milling cutter and spindle are housed in a bearing which is forged as a part of the slide and are driven direct by an air motor. The cutter is fed into the work by horizontal and vertical hand feeds. A Morse taper shank is provided at the upper end of the spindle for the air motor shaft and a Morse taper socket at the lower end to accommodate the milling cutter.

Boiler Makers' Convention Well Attended

Three Hundred Members Present at Chicago Meeting on May 20-23; Several Important Addresses

THE opening sessions of the fifteenth annual convention of the Master Boiler Makers' Association held at the Hotel Sherman, Chicago, May 20 to 23, were attended by about 300 members of the association and 125 representatives of member companies of the Boiler Makers' Supply Men's Association. Exhibits were shown by 57 companies belonging to the supply association.

Leading Addresses During the Meeting

E. W. Young, assistant to the general superintendent motive power, Chicago, Milwaukee & St. Paul, president of the association, called the meeting to order Tuesday, May 20, at 10 a. m. Following the usual opening exercises, H. T. Bentley, general superintendent of motive power, Chicago & North Western, was then introduced and, in an address to the men on their duties as the leaders in locomotive boiler maintenance work, expressed his appreciation and admiration of all craftsmen who have gone through the arduous days of the apprentice and journeyman and finally reached their positions as the masters of their trades. These men in whose hands rest the responsibilities of properly conditioning the motive power of the nation, Mr. Bentley said, should strive to be worthy of their trust and in every way better themselves in their work, and the managements of the railroads should see to it that their master boiler makers were present at the conventions.

On the technical phases of the work of the association, Mr. Bentley expressed the hope that the association in its discussions would be able to throw light on the problem of pitting and corrosion of boilers, which so far has found no solution in the laboratory or in the hands of practical investigators. He outlined the need of apprentices in the shop who would later on be fitted to carry forward the work of the masters of the trade who were retiring. Water treatment and its value in cutting operating and maintenance expense in bad water districts, quality of material and possible improvements, and the work of the chief inspector of the Bureau of Locomotive Inspection in developing and standardizing the use of water columns, were all commented on in his address.

The president's annual address which followed was mainly devoted to an outline of the duties of members of the association in faithfully attending all sessions of the convention and getting the maximum benefit out of the proceedings to improve methods in their own shops.

A communication from Hon. Herbert Hoover, secretary of the Department of Commerce, was read by the secretary asking for the co-operation of the association in improving the movement of coal during the summer and early fall months of the year. A memorandum promising the co-operation requested to the best of the ability of the members in their capacities in the maintenance of motive power of the country is to be prepared and forwarded to Mr. Hoover.

An invitation to send a representative to sit in on the Advisory Council of the Federated American Engineering Societies is being acted on by the executive board.

The Wednesday session opened with an address by J. E. Bjorkholm, assistant superintendent motive power, Chicago, Milwaukee & St. Paul, in which he emphasized the duty of every railroad officer to improve service with safety. In this the boiler maker has a most important duty, the promotion of safety through proper maintenance. Boilers are sometimes responsible for engine failures, but their number is fast decreasing. Clean boilers are safe boilers and the importance of keeping them free from scale and mud cannot be too strongly stated. No locomotive is usable unless boilers are in proper condition and officials are beginning to recognize the importance of boiler makers in maintaining service.

The meeting Thursday morning opened with an address by John Purcell, assistant to the vice-president in charge of operations, A. T. & S. F. He outlined the problems that have confronted the maintenance facilities of the railroads with the introduction of heavier power, and the part played by the inspection departments from the general boiler inspector down in keeping locomotives in safe condition. Proper cleaning of boilers by frequent washing is one of the best methods of preventing failures, he said. Careful inspections of staybolts, flues and all parts of boilers subject to breakage or cracking, with complete reports of such inspections, should be made. The subject of welding as it is practiced on the A. T. & S. F. system was also touched upon by Mr. Purcell.

Following this address, A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, outlined the work of his department. An abstract of Mr. Pack's address will appear in a later issue.

At the Friday morning session, W. J. Tollerton, general superintendent motive power, C. R. I. & P., addressed the convention. In his remarks he mentioned the development of the locomotive boiler from the day when it was only required to supply the cylinders with steam to the present stage when it must furnish high pressure, superheated steam to three, four and six cylinders, feedwater heaters, stokers, headlight generators and to heat trains. With this advance, the position of the boilermaker has become increasingly important and he is recognized today almost universally as the most important individual in the maintenance of the locomotive. If his work—that is, the work of his department—is not properly done, the locomotive is neither economical nor safe. The thermic syphon, according to Mr. Tollerton, is a great promoter of boiler efficiency by increasing the firebox heating surface, improving circulation and benefiting flue performance. It also adds materially to the safety of the firebox by providing additional support to the crown sheet.

In referring to the Federal Inspection Law of 1915, Mr. Tollerton stated that he considered it one of the greatest pieces of legislation ever passed. He considered the Federal Locomotive Inspection Department the most conservative body of men in Washington at the present time and has always admired the position of aiding the roads assumed by the chief inspector. The work of the department has greatly decreased accidents on the railroads of the country and has been invaluable in promoting their efficiency and safety.

Election of Officers

The following officers elected for the coming year: President, Frank Gray, tank foreman, C. & A.; first vice-president, Thomas F. Powers, system general foreman boiler department, C. & N. W.; second vice-president, John F. Raps, general boiler inspector, I. C.; third vice-president, W. J. Murphy, general foreman boiler maker, Penn., Fort Wayne; fourth vice-president, S. M. Carrol, general master boiler maker, C. & O.; secretary, H. D. Vought, New York; treasurer, W. H. Laughridge, general foreman boiler maker, Hocking Valley.

[Abstracts of the more important papers and discussions of the convention will appear in a later issue.—Editor.]

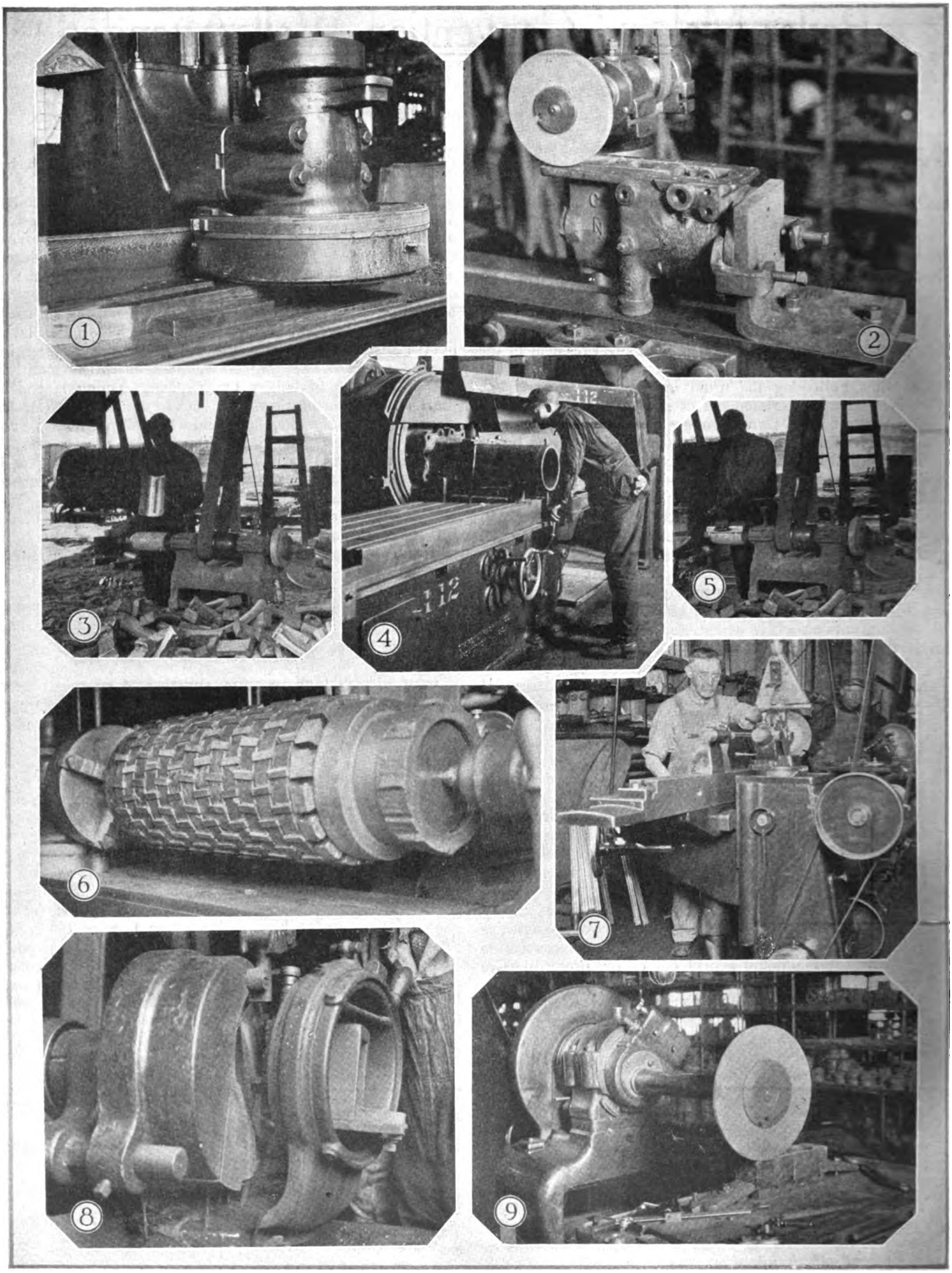
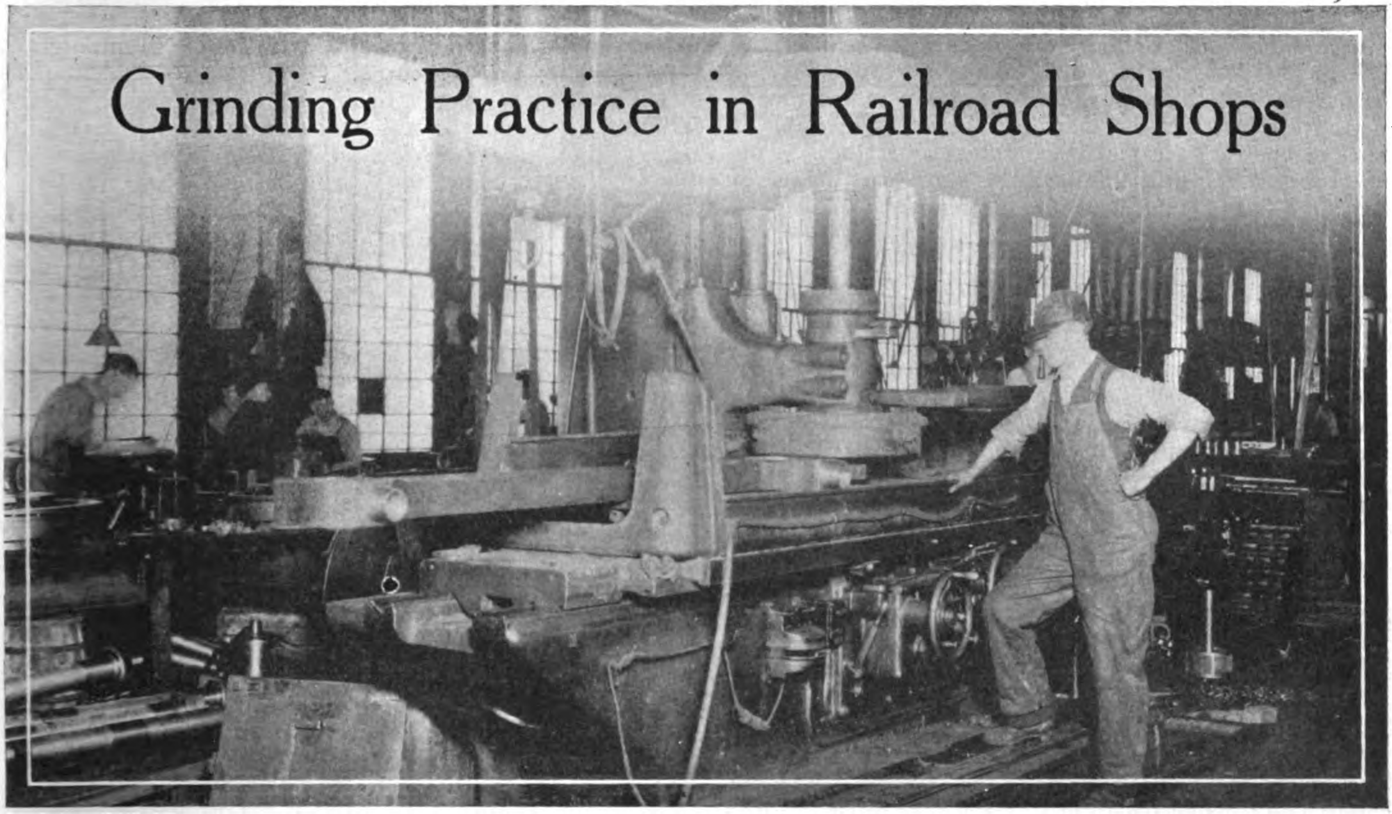


Fig. 1—Locomotive Links on a Pratt & Whitney Surface Grinder; Fig. 2—Grinding Air Brake Valve Seat on Wilmarth & Morman Machine; Figs. 3 and 5—Diamond Standard Grinder for Journal Brasses and Brake Shoes; Fig. 4—A Diamond Horizontal Spindle Grinder; Fig. 6—A Sectional Milling Cutter Being Ground on a Brown & Sharpe No. 3 Universal Machine; Fig. 7—A Universal Tool Room Grinder; Fig. 8—Bolt Cutter Being Ground on a Gisholt Machine; Fig. 9—A Heald Grinder on Small Surface Job.

Grinding Practice in Railroad Shops



Grinding the Face of Side Rods on a Pratt & Whitney Machine

Increased Production and Improved Accuracy and Finish Have Been Effected by the Use of Grinders

By Marion B. Richardson

A LARGE share of the credit for the development of the grinding machine must be given to the automobile and other industries engaged in quantity production work under competitive conditions. The railroad shops, working under the usual conditions and handicaps peculiar to repair shops have been required to take a second place in initiating improvements both in the utilization of machine tools and the installation of better methods and shop equipment. Although insufficient appropriations and limited earnings have limited the application of production methods to locomotive and car repair work, the railroads are gradually adopting the central production shop idea, in which the majority of repair parts are blanked out in a semi-finished state. In many cases, these parts may be fitted more economically and accurately on grinding machines than by any other methods. It has been found in various railroad shops where grinding machines are in use that a better finish, as well as full control of the tolerances desired, can be obtained more economically and more quickly than by the old methods of turning, filing or lapping. Standard measurements can be maintained and better work is also turned out, which has a material effect on the life of a locomotive between shoppings.

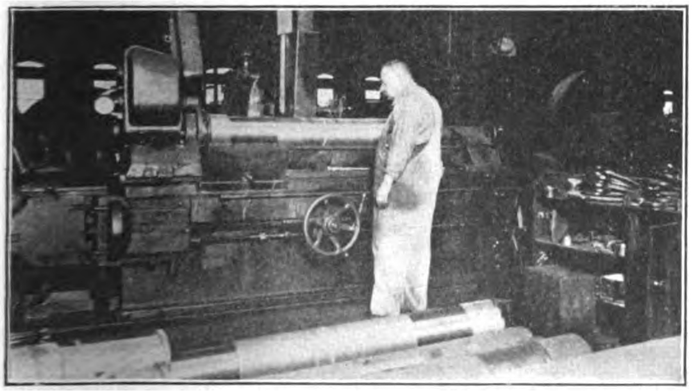


Fig. 10—Driving Axle Journals Being Finished on a Landis No. 27 Grinder

Perhaps the greatest difference of opinion relative to grinding practice among railroad shop men is in the selection of wheels and the proper feeds and speeds to be used on different jobs. The type of wheels and machines used are relatively uniform throughout the various shops. A number of manufacturers have made careful studies of railroad shop grinding requirements and have developed tools especially adapted to such work. The grinding requirements of the automobile industry are similar to those of the railroads in many ways and as a result some of the machines designed primarily for the automobile trade have been found suitable for railroad work.

The grinding machine is essentially a manufacturing tool. It is capable of an output in the various kinds of work for which it is being used in railroad shops, many times that of the old method. Take, for example, the finishing of 9½-inch air pump cylinder piston rings. By the old method, the production of from 90 to 100 rings was a good day's work. Incidentally there could also be deducted from this amount a fair sized loss due to breakage during the process of finishing. As a comparison, a rotary surface grinder is able to finish 40 rings an hour with practically no waste. In cases where the ring does break, the work of finishing can

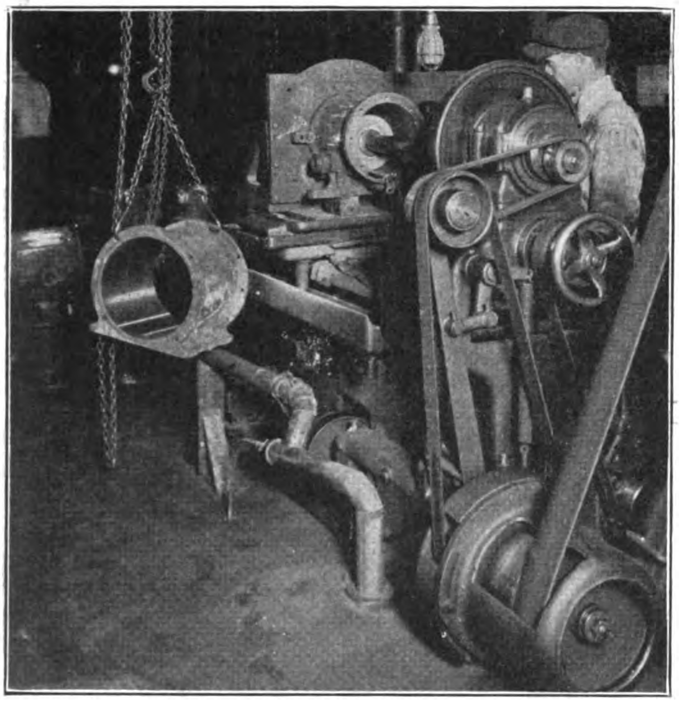
be completed and the cut made at the point of the break.

In other kinds of grinding work, such as the bearing surfaces of pins and the bore of bushings, all fitting may be done at the time they are finished and not at the time a locomotive comes into the shop for repairs. Where this is practiced both the pin and the bushing are renewed at the same time. Of course this demands interchangeability of parts, and that pins and bushings be standardized.

Tool Room Grinding Equipment

It is safe to say that there is some form of grinding machine in every railroad shop tool room on this continent. A tool room that is doing any business at all has at least a wet grinder, double grinder and twist drill grinder. However, the demand on the tool room has increased with the development of production work. The milling machine is rapidly growing more popular with the shop man and the lathe and planer are also being developed into tools for specialized production. This means greater demands on the tool room from the standpoint of maintenance of cutting tools.

Universal grinders, similar to that shown in Fig. 7, have



The Internal Grinder Is Playing an Important Part in Air Pump Maintenance

established themselves as an essential part of tool room equipment. This illustration shows a small universal grinder grinding a reamer, 18 in. long, 1 13/32 in. in diameter with a pitch of 1/16 in. per foot in 20 minutes. Fig. 6 shows a sectional milling cutter, used on a large Newton slot miller, which is 6 in. long and 9 in. in diameter, being ground on a Brown & Sharpe No. 3 Universal grinder. This cutter was trued up and each section backed off in approximately six hours. Maintenance of bolt cutting dies is another important tool room job for which grinding machines have been adapted and Fig. 8 shows a Landis bolt cutting die being ground on a Gisholt machine. This machine, which has been in service over eight years, can regrind a complete set of four dies in six minutes.

Axle Fits, Journals and Car Wheels

The practice of grinding journals and wheel fits is becoming quite general in the larger shops. As a rule the axle journals are rough turned and ground, no finishing cut being taken. The Landis grinding machine, shown in Fig. 10 is an example of the type of machines used for finishing driving axles. This work usually requires from four to five minutes' actual grinding time on journals 12 in. long.

The grinding of car wheel bores is practiced to some extent in Europe. An article was published in the April, 1923, issue of the *Railway Mechanical Engineer* in which certain European grinding practices, particularly those used in Belgian car shops, were described. The Belgians claim that it is obviously of little avail to grind the wheel seats on the axle and then apply a car wheel that has a rough bore. Page 237 of the issue referred to shows an illustration of an Eng-

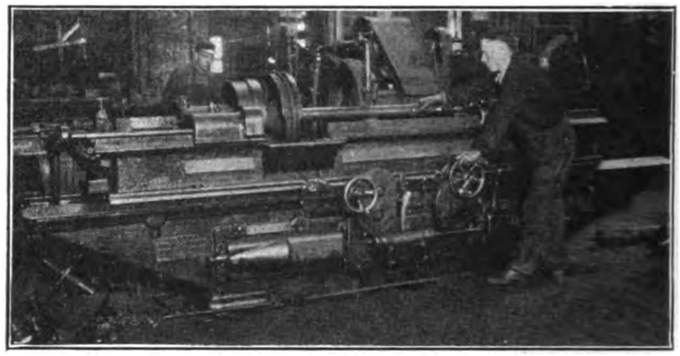


Fig. 11—Finishing a Piston Rod on a Norton Cylinderical Grinder

lish machine that has been designed especially for such work.

Some shops are grinding cast iron car wheels—a practice that is being investigated by the Committee on Wheels of the Mechanical Division of the A. R. A.—in order to remove any eccentricity that may have shown up after mounting and also to remove flat spots. A large eastern road has adopted the practice of grinding new cast iron wheels which has resulted in better wheel service.

Pistons, Motion Work Pins and Bushings

Fig. 11 shows a piston being finished on a 32 in. by 96 in. Norton cylindrical grinder that has been in service for over

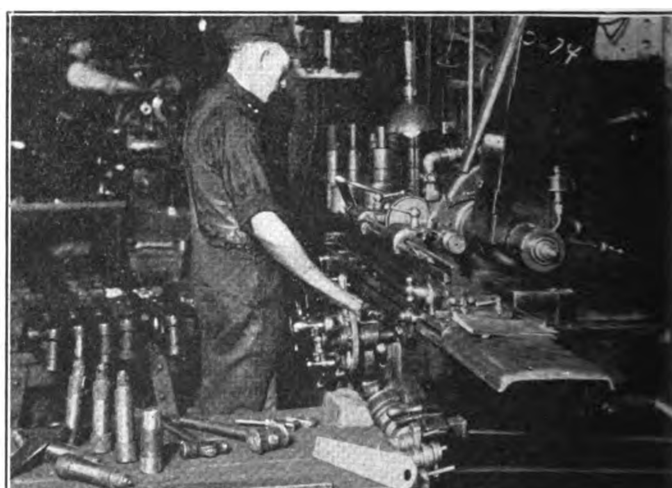


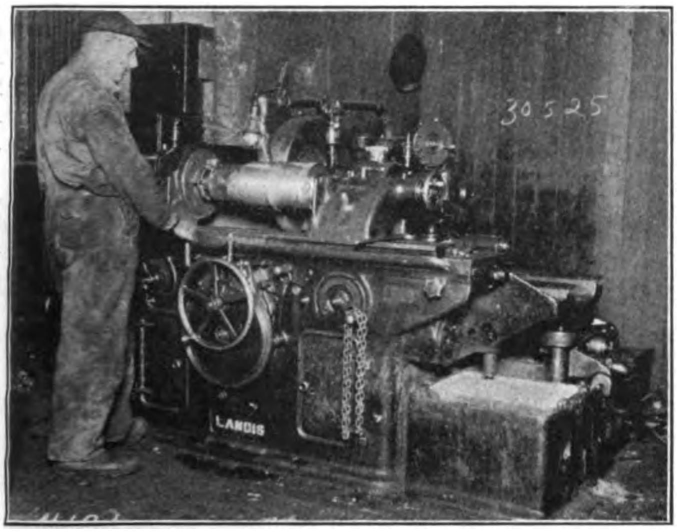
Fig. 12—Motion Work Pins Being Ground to a Fit on a Norton Machine

ten years. In cases where the rods are in extremely bad condition a roughing cut is first taken on a lathe, but usually the rods are sent direct to the grinding machine. The time required to finish a rod varies from 15 to 30 minutes.

Experience has shown conclusively that motion work pins can be ground much quicker than by turning and filing. Case hardened or soft pins are finished in practically the same time. The illustration, Fig. 12, shows another Norton

machine grinding a motion work pin to a fit in the short time of four minutes. One operation completes the job.

Frequently, in the case of the taper ends of valve motion pins, the grinding wheel will cut below the hardened sur-



The Advantage of Grinding Crank Pins Is Well Known to Many Shop Men

faces. However, as the taper ends are a tight fit and not a running fit in levers, it makes practically no difference if these surfaces are hard or soft. The principal requirement is to obtain a hard surface on the journal or wearing surface.

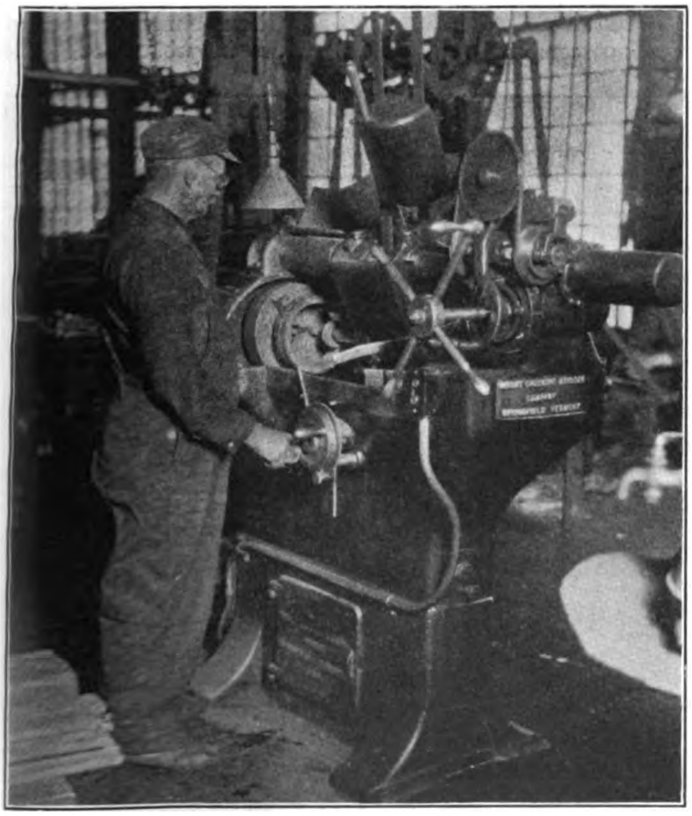


Fig. 13—Grinding a 2½-In. by 3-In. Motion Work Bushing on a Bryant Chucking Machine

A number of railroad shops have grinding machines that are equipped with automatic in-feed and throw-out attachments, by which the wheel is fed against the work automatically. From the standpoint of production, this is a desirable feature, as the operator can change the driving dog on one pin while the other is being ground.

A Bryant chucking grinder is shown in Fig. 13, grinding the bore of a motion work bushing. In shops where this sort of work is done, it is the practice to renew both the pin and bushing at the time of repairs to the locomotive. This eliminates all work on these surfaces when a locomotive comes into the shop, as all such parts are ground to standard and the fitting of companion pieces is done at the time of quantity production. Maintenance of bushings on valve motion levers and side rods constitutes a considerable proportion of shop work, and it is this work that has been a big factor in the development of the grinder and production work.

Internal Grinding

One of the most outstanding developments in railroad shop work is the utilization of the internal grinding machine. A number of machines for grinding links have been described

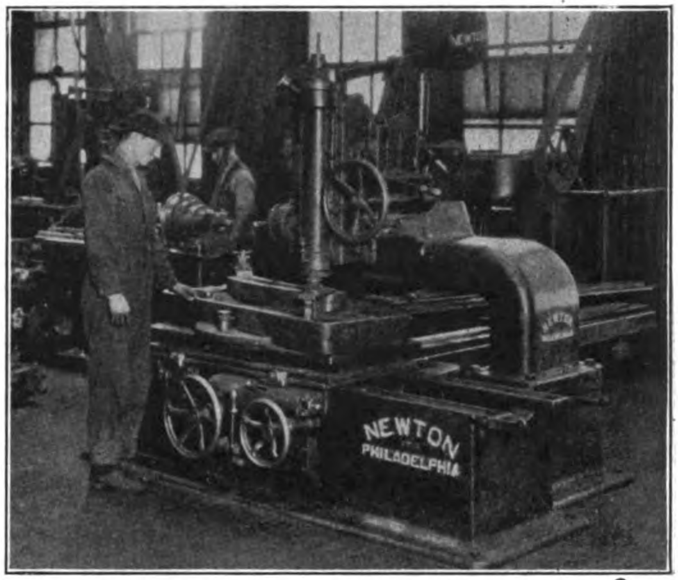


Fig. 14—A Newton Link Grinder

at various times in the *Railway Mechanical Engineer.* A Newton link grinder is shown in Fig. 14. This machine has been in service for seven years and it requires approximately one hour to complete both sides of a link, like the one shown in the illustration.

The Heald Machine shown in Fig. 15 has been adapted to a wide variety of internal grinding, due largely to an extensive study by the manufacturer of railroad shop requirements. Various jigs and devices for holding bushings, air brake valves, air pump bushings and for finishing the holes in valve levers and side rods may be used on this machine. Machines of this type are not only good for quantity production but can be used to advantage for quick repair jobs.

The time usually required to grind repair parts is governed to a large extent by the location of the part to be fitted and the facilities for holding the work, measuring and calipering. Such work is usually done in a separate department and the various parts are piled near the machine. In the majority of shops the time from floor to floor averages about as follows:

	Min.
Side rods, fitting knuckle pin taper ends	12
Side rods, knuckle pin, straight bearing	10
Side rods, knuckle bushing, outside	10
Side rods, internally ground	20
Triple valve, brass cylinders	7
Valve motion pins, fitting taper ends	10
Valve motion pins, bearings when individually ground	5
Valve motion pins, quantity production	25
Valve motion bushings, outside	8
Valve motion bushings, inside	15
Valve levers, truing holes	10

While this time may appear excessive to a grinding expert, it should be remembered that each article ground is usually

of a different size and that it is necessary to caliper each part individually so as to fit its companion piece, measure the piece ground and in addition make allowances for a drive or running fit.

Surface Grinding

The surface grinder has established for itself an important place in the scheme of railroad shop production. A number of machines, such as the Blanchard grinder shown in Fig. 16, are equipped with magnetic chucks for holding small work. Such an arrangement makes the work of production in large quantities an easy problem in any main shop.

The following table will give the reader an excellent idea as to what can be accomplished with various jobs on a surface finder.

	Material	Condition received	No. sides ground	Amt. stock removed per side, in.	Limits, in.	No. pieces ground per hour
Crankpin washers	Steel	Rough	2	.0312	±.001	75
Grease cellars	Cast iron	Rough	2	.125	±.005	15
Link	Steel	Rough	2	.125	±.006	6
Main rod key, 12"x2½"	Steel	Rough	2	.0625	±.002	36
Main rod key, 10"x3"	Steel	Rough	2	.0625	±.002	30
Packing rings, 24" diam	Cast iron	Machined	2	.010	±.0003	20
Pedestal brace	Cast steel	Rough	2	.125	±.003	9
Slide valves	Cast iron	Rough	2	.1875	+.006	6
Tire retaining strip	Steel	Rough	2	.0625	Clean up	27

Another type of surface grinder to be found in many railroad shops is the Diamond horizontal spindle grinder shown in Fig. 4. This machine is used for finishing guides, exhaust pipe ends and flat work of a similar nature. Shoes may also be finished on a machine of this order, by changing the patterns so as to leave about 1/32 in. or 1/16 in. stock to be removed instead of the usual ¼ in. or ⅜ in. Of course, the inside of the shoe has to be planed.

The Manufacturers' Service Departments

Practically all of the larger machine tool manufacturers maintain service departments for the benefit of their clients. The outstanding developments in the broader use of the grinding machine have been in shops where the manufacturers' service representatives have been permitted to make studies and run tests. A machine tool means an investment from which the owner should strive to obtain the greatest returns. Few shop men are familiar with the various types of wheels, few are acquainted with the proper use of the diamond dresser or the various precision instruments that can be used to good advantage with grinding machines for quality production.

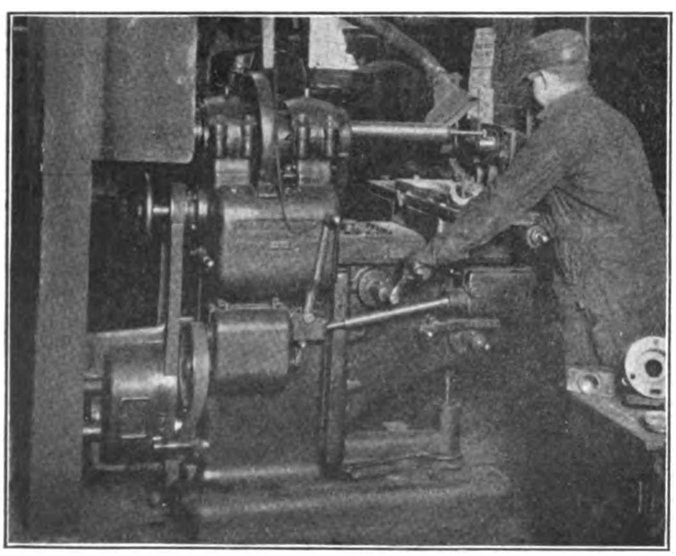


Fig. 15—A Heald Internal Grinder May Be Used for Finishing Small External Surfaces—the Job Shown Is a Link Trunion

Influence on Standardization

The flexibility of the grinding machine in adapting itself to various sizes of work is one of its features. Its output is not automatic and standard sizes are not required, as in the case of a majority of automatic machine tools. Many different jobs can be performed on a grinder of the universal type. The big problem, however, is to get enough work to keep such a machine from standing idle part of the time. Here is where standardization becomes advantageous.

Doubtless, the mechanical officer and shopman will wonder whether a grinding machine is worth all the trouble and expense of standardization. That question is answered entirely by the number of locomotives the shop has to keep in repair and the parts it has to handle. If a shop is standardizing locomotive parts to cut down stores keeping and material handling costs or if it is standardizing to facilitate work in the erecting and machine shops, then the grinding machine will prove to be a valuable adjunct in completing the primary objective.

The advantages to be obtained through standardization are not complete without an increase in production. The grinding machine meets the demand for greater production and in addition a much better quality of work is obtained. Quality pays its dividends in satisfactory service. The grinder is developing as locomotive parts are becoming standardized and the railroad shops are rapidly awakening to its advantages.

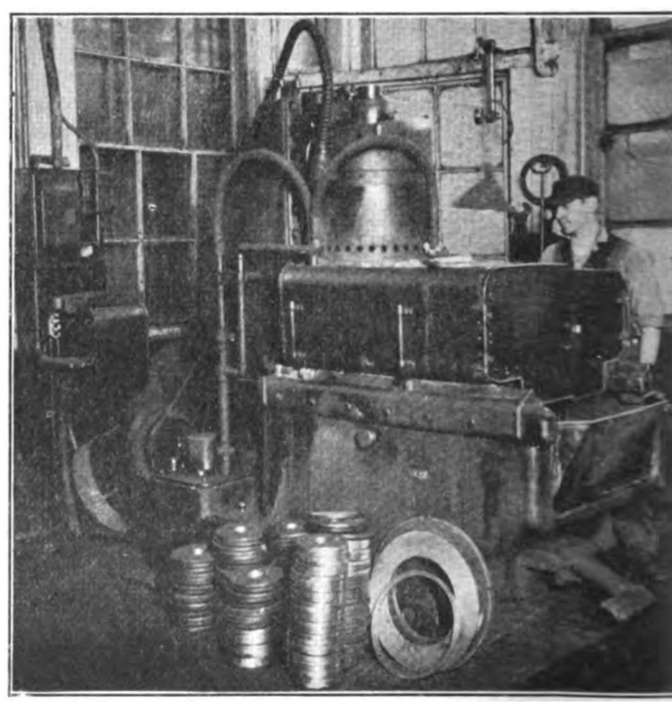


Fig. 16—A Surface Grinder Like the Blanchard May Be Used for a Variety of Work

Meeting of Air Brake Association at Montreal

Freight Car Foundation Brake Design and Operation of the Triple Valve Test Rack Discussed

An attendance of over 300 was registered at the thirty-first annual convention of the Air Brake Association at Montreal, Que. This included representatives of railroads in practically every section of the United States and Canada. The sessions were held May 6, 7 and 8 at the Mount Royal Hotel.

S. J. Hungerford Pays Tribute to the Work of the Association

The opening session of the convention was called to order by the president, George H. Wood, General Air Brake Instructor, Atchison, Topeka & Santa Fe. Mayor Duguette, of Montreal, made a brief address in which he welcomed the association to the city, pointed out its many advantages as a place to hold conventions and outlined a number of the historical points of interest. He was followed by S. J. Hungerford, vice-president of the Canadian National, who gave an interesting account of the development of the railways of Canada and the various reasons why the government was required to take over a part of the railways. A large part of Canada is undeveloped and sparsely settled. However, for the welfare of the country as a whole, as well as for the benefit of those who live in the outlying districts, Mr. Hungerford said, it is necessary to maintain a large number of lines that must be operated at a loss. It was out of the question to expect private owners to operate under such conditions, so rather than have the lines abandoned, it was decided to take them over and operate them under the present system. Mr. Hungerford brought out the fact that this was the most extensive undertaking in the operation of a public utility by any government, and that the management of the Canadian National felt that its success or failure was being watched by all the world.

Mr. Hungerford paid a tribute to the work of the Air Brake Association and told of some of the improvements that had been made in the air brake since it was first placed in operation. He attributed a large part of the development of air brake maintenance to the efforts of the association. He mentioned the fact that in the early days when serving as a machinists' apprentice, his initiation into the mysteries of the air brake also included what was practically an oath to secrecy. That times had changed was well evidenced by the eager and open discussion at the annual conventions of air brake men from the United States and Canada.

George H. Wood (A. T. & S. F.) President

Address by President Wood

President Wood in a brief address extended a welcome to the old and new members and outlined the program and the work of the convention. He brought out the fact that the advent of train control opened another field of endeavor for the air brake man and should be added to the program of the association. Mr. Wood also recommended that provisions for life membership for those who have been members of the Air Brake Association for 25 years or more should be made.

Following the open exercises, the convention took up the regular program.

The following papers were read and discussed: Brake Pipe Leakage, a committee report read by W. W. White (Michigan Central); Condemning Limits of A. R. A. Standard Triple Valve Parts, a committee report read by R. M. Long (P. & L. E.); Reclamation of Hose and Fittings, by James C. Griggs (A. T. & S. F.); Reclamation of Air Brake Material, by A. Skinner (A. T. & S. F.; Passenger Train Handling, contributed by the Central Air Brake Club and read by James Elder (C. M. & St. P.); The Triple Valve Test Rack Operator, contributed by the North-West Air Brake Club and read by Mark Purcell (Northern Pacific); Recommended Practice, a committee report read by H. A. Clark (Soo Line), and Methods of Interesting and Instructing Employees in Maintenance and Operation of Air Brake Equipment, by J. P. Stewart (A. T. & S. F.). The various papers and reports were well prepared and presented. As a result the discussions brought out many important points.

C. M. Kidd (Virginian) First Vice-President

R. C. Burns (Penna.) Second Vice-President

M. S. Belk (Southern) Third Vice-President

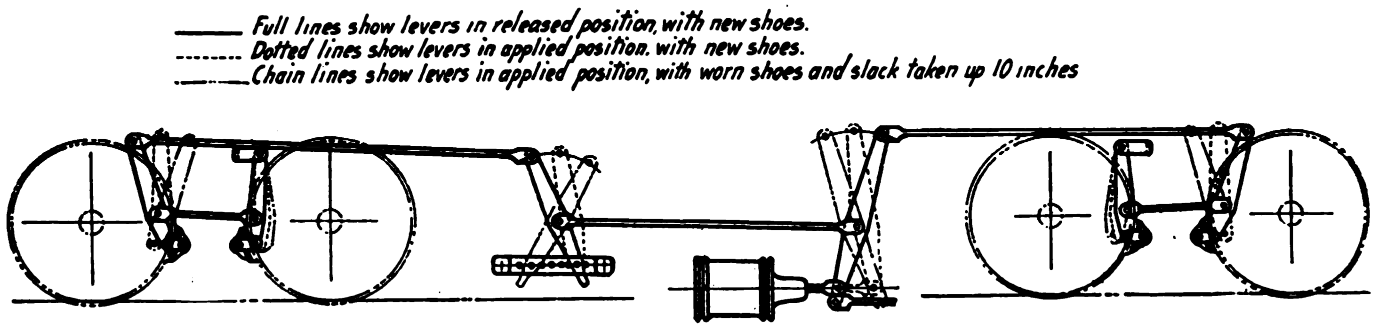
F. M. Nellis (Westinghouse Air Brake Co.) Elected Life Secretary

Freight Car Foundation Brake Design

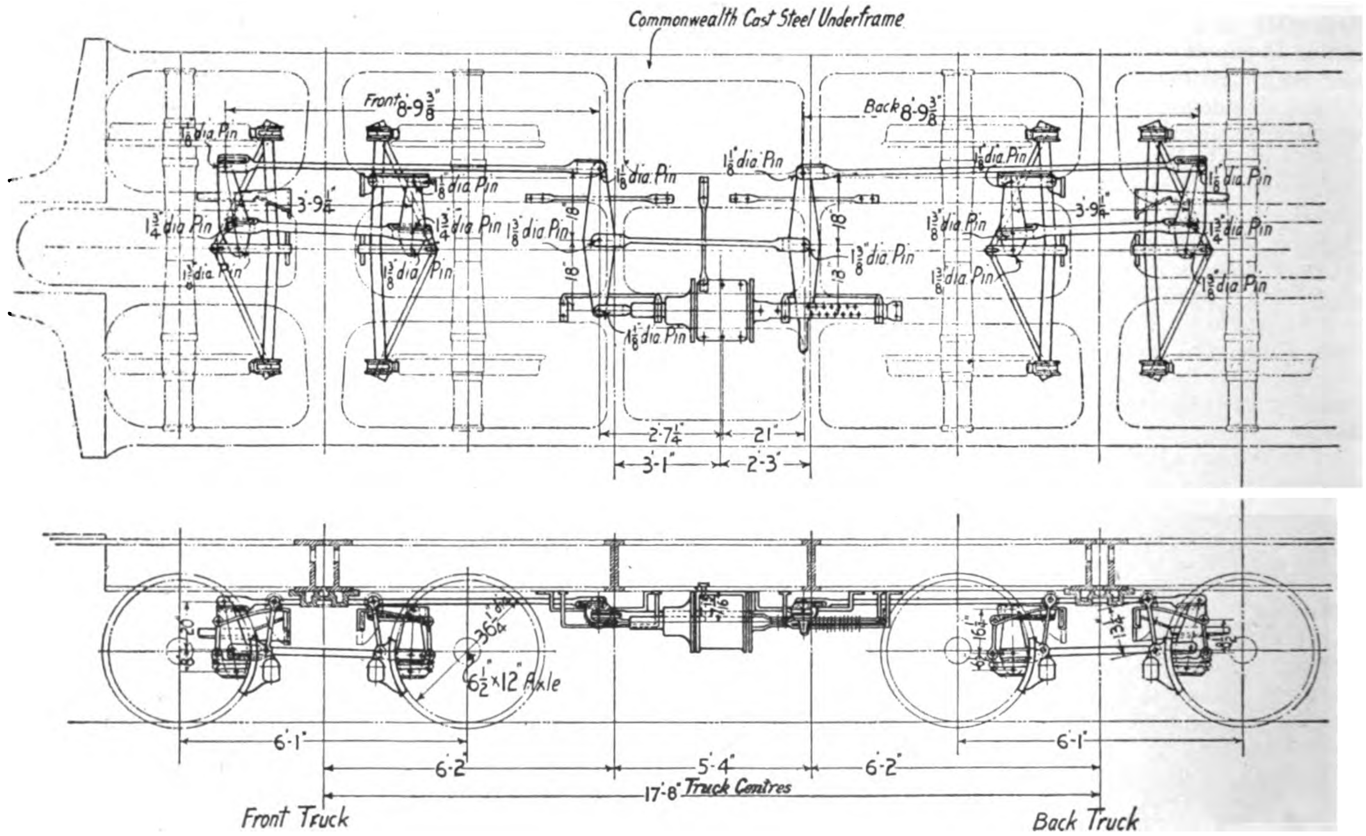
Following is an abstract of a paper presented by W. G. Stenason, General Air Brake Inspector, Canadian Pacific:

Experience shows that good ideas have been developed from time to time in all lines of railway work only to be abandoned for one reason or another before the conditions that actually required their use had been thoroughly understood or appreciated. This applies particularly to an early form of freight car truck foundation brake gear that was tried by a number of roads and finally abandoned in favor of the present recommended design, which calls for the location of the bottom rod below the spring plank and the live truck lever on the inside of truck.

The earlier form had the bottom rod located above the spring plank and the live truck lever located on the outside of the truck, or, in other words, the top pull rod passed over the top of the truck bolster. This design has been revived in certain localities and has been applied with certain modifications to locomotive tenders and cars of large capacity used in heavy grade service. Under present conditions of long trains equipped entirely with air brakes and the necessity of moving trains through terminals with dispatch, the time has arrived for the general adoption of a simpler and more effective method of adjusting brake shoe wear. One of the illustrations shows the application of a manually operated slack adjuster used on a number of the Canadian railways. With this arrangement it is only necessary to move the adjusting lever the same distance as it is desired to lengthen or shorten the piston travel. The combined advantages of the modified truck brake rigging and the manually operated slack adjuster on the car body can be summed up as follows:



Application of a Manually Operated Slack Adjuster to a Locomotive Tender



General Arrangement of the Proposed Foundation Brake Rigging as It Is Applied to a Locomotive Tender

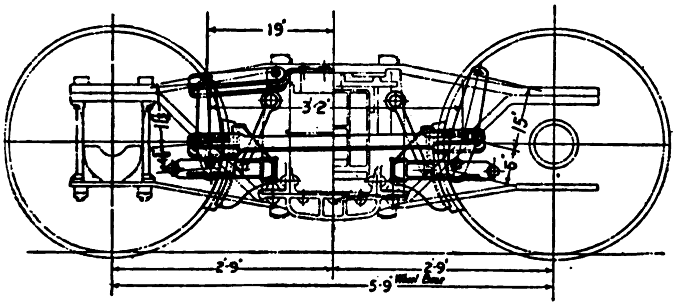
First: To prevent any portion of the brake rigging extending below the center line of the brake beam, thereby materially increasing the clearance from the top of the rail.

Second: With cars equipped with cast iron wheels, adjustments to compensate for brake shoe wear may be handled from one point on the car body, thus obviating the necessity of the removal of the cotters and brake lever pins on the trucks.

Third: The truck brake rigging cannot drop on the track in case any pins happen to work out of position, as the bottom connecting rod is located above the spring plank.

Fourth: Both easier and quicker adjustments can be effected with a slack adjuster located on the car body in the position shown.

In the installation of this design, it is important that care be exercised in arranging the truck levers in order that ample clearances will be provided for the movement of the lever so as to compensate for complete brake shoe wear. In doing this, it has been found necessary to establish new

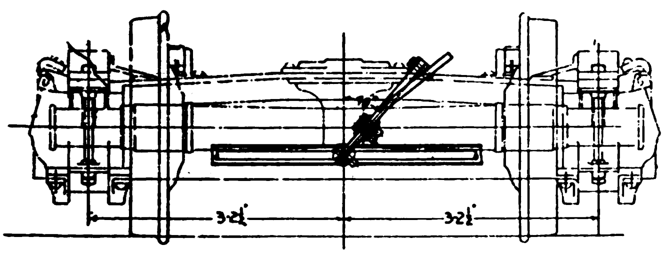


Location of the Brake Levers with Respect to the Truck Bolster and Truck Frame

lever lengths and change the total truck lever ratio so as not to exceed a ratio of 5 to 1.

The drawing shows three holes in each jaw of the bottom connecting rod. The purpose of these additional holes is to provide a standard bottom rod for trucks having different lengths of wheel base and not for adjustment as might first be supposed.

A car equipped with this design is rarely found on a repair track with a damaged truck brake rigging. On the other hand, cars having the bottom rod below the spring plank are frequently found on the repair tracks during certain months of the year with defective or missing truck brake gear.



Drawing Showing the Bottom Connecting Rod Clearances

Discussion

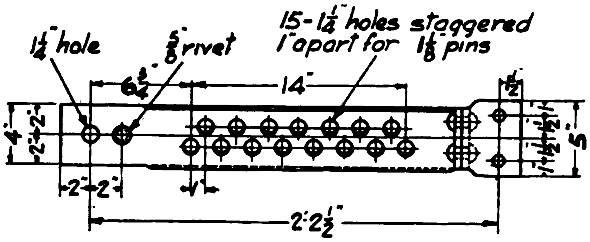
William Clegg (Canadian National) briefly outlined the history of the proposed brake design and stated that the Canadian National Railways have now approximately 40,000 cars fitted with this type of brake gear. From the standpoint of strength of material and dimensions this design is in accordance with the A. R. A. requirements. He brought out the fact that there was a much better condition of clearances on account of the fact that all of the rods were placed high enough so that they could not be torn off in case the car was derailed or had been running through ice and snow. He also stated that it was his intention, through the Association of the Railway Men in Canada, to ask the A. R. A. to accept this design of brake gear as an alternative standard. Considerable trouble has been encountered with the present A. R. A. standard design, especially in the northern United States and Canada, on account of having to contend with difficult operating conditions in the winter months. A number of the members reported that on their roads where they had attempted to apply this type of brake gear there had been considerable difficulty, particularly with the bottom rod, in getting the proper height on their standard trucks. It had been found that the majority of standard trucks were not suitable for this particular type of brake gear.

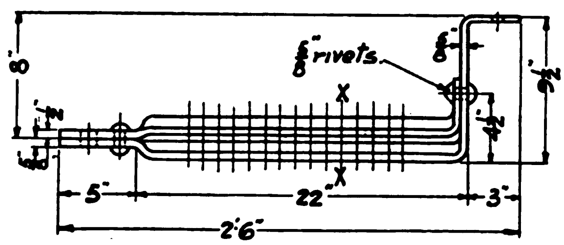
Closing Business

F. M. Nellis (Westinghouse Air Brake Company) was elected secretary of the association for life. The following officers were elected for the ensuing year: President, C. M. Kidd, Virginian; first vice-president, R. C. Burns, Pennsylvania; second vice-president, M. S. Belk, Southern; third vice-president, H. A. Clark, Soo Lines. The following were elected members of the Executive Committee: H. L. Sandhass, C. R. R. of N. J.; W. W. White, M. C.; H. A. Flynn, D. & H.; William Clegg, Canadian National, and R. M. Long, P. & L. E.

Excursion to St. Anne de Beaupré

A feature of the convention was a trip to Quebec and St. Anne de Beaupré. This excursion was conducted jointly by the managements of the Canadian National and Canadian





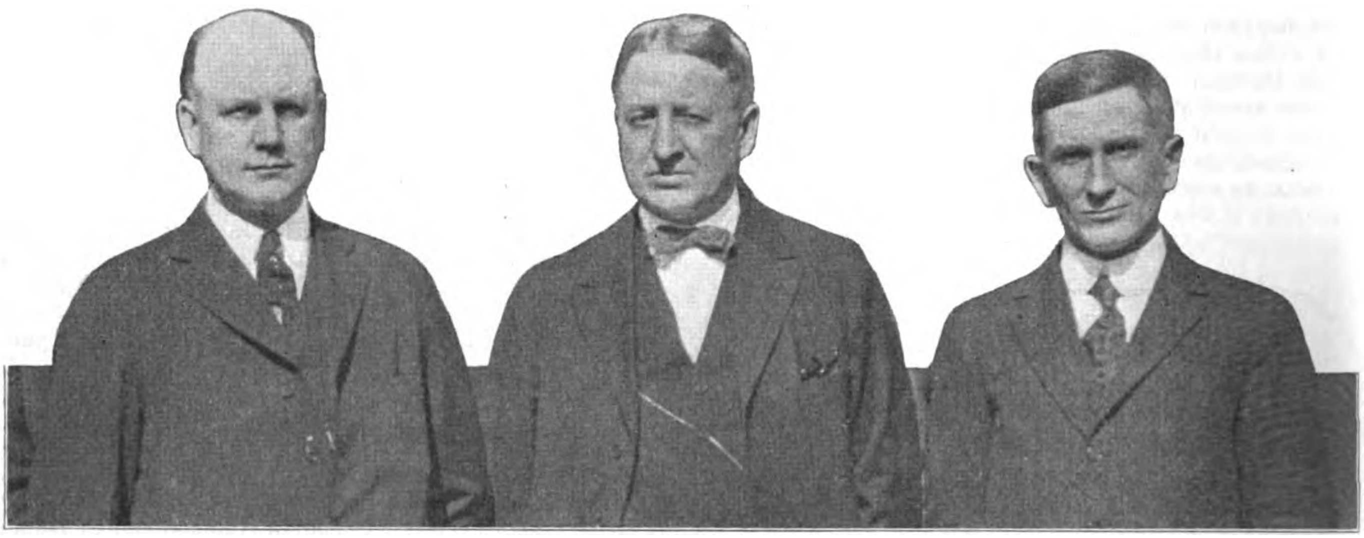
Detail of the Dead Lever Guide for the Proposed Foundation Brake Gear

Pacific, who provided a special train, the observation car of which was equipped with a radio receiving set. A. J. Hills, assistant to the vice-president, Canadian National, broadcasted an address to the members, in which he spoke in part as follows:

"It is, I think, quite remarkable that the use of air for braking power has so well withstood the test of time. In the midst of the greatest advances in electrical and mechanical development, compressed air as a force for applying and releasing brakes holds practically the entire field against all comers. While in almost every mechanical development electricity assists or performs, when it comes to stopping trains by the application of brakes the actual work is done without electrical aid. Engine and car brake equipment has had to be developed to keep up with the great advances made in weights of trains, and it is a remarkable tribute to those who have had the work in hand that it has kept pace so well with general railway development.

"It seems that we are on the threshold of a new great development whereby trains will be controlled by air orders as well as by air brakes. Radio work has shown such wonderful progress lately that the management of the Canadian National has decided that it would be worth while to get in the game. This demonstration of what can be done in sending to a moving train will, we hope, prove to be of interest to you."

[Abstracts of other papers and discussions will appear in an early issue.—EDITOR.]



Three Sponsors of the Milwaukee Annual Mechanical Staff Meeting Plan—Left to Right: R. W. Anderson, Superintendent of Motive Power; C. G. Juneau, Master Car Builder, and L. K. Sillcox, General Superintendent of Motive Power

Annual Staff Meetings of the C. M. & St. P.

Five Years' Experience Proves Value of Convening Various Groups of Mechanical Department Officers

THE need of greater effort on the part of the railroads to disseminate useful information among their employees, both in regard to the more technical and practical questions of the various occupations and departments and also in regard to the wider scope of the relationship of railroads to the public, has been acutely felt by officers of the Chicago, Milwaukee & St. Paul and has expressed itself in definite educational efforts along various lines. The many phases of the larger questions of railroad operation in relation to the financial and economic problems of the day has, during the past years, been ably and concisely presented to the population of the territories which the Chicago, Milwaukee & St. Paul serves by H. E. Byram, president of the road, as well as by other of the operating officers.

The educational campaigns carried on within the mechanical department, both locomotive and car, were described in detail in a paper presented before the Western Railway Club* by C. G. Juneau, master car builder, at its January, 1922, meeting and as pointed out by him, the desirability of gathering the supervisors of the departments to annual meetings was based on the results obtained through these efforts. It was felt that some means should be found to make the experience and knowledge of the individual supervisors, obtained through years of service, accessible to all and also to provide means for an exchange of ideas and a discussion of common problems and practices on the railroad.

First Departmental Meeting in 1918

The first departmental meeting was held in Milwaukee during the fall of 1918 and consisted of supervisors of the car department, the attendance including district and general foremen as well as representatives of the staff of the master car builder. The success of this meeting was such that it was decided to extend the benefits derived from these yearly gatherings to supervisors of all the different crafts within the mechanical department so that last year staff meetings were held as follows:

Car department	fifth annual meeting
Master mechanics	third annual meeting
Traveling engineers	third annual meeting
General foremen, blacksmiths and tool room foremen	third annual meeting
Boilermaker foremen and inspectors	third annual meeting
Air brake foremen	second annual meeting

*See the *Railway Mechanical Engineer* for April, 1922, page 213.

About three years ago special apprentices with college education were assigned, one to each of the larger shops, and it was found desirable to give them also an opportunity to come together and discuss the problems they encounter in their work. Their first annual meeting was held last year, immediately following that of the master mechanics.

The staff meetings are held during the summer and fall. A committee consisting of the superintendent of motive power, master car builder, assistant superintendent of motive power, mechanical engineer, supervisor of air brakes and general boiler inspector, met during the winter to set the dates of the meetings as well as to select subjects and assign them to the men who are to prepare the papers. As a rule the opening discussion is also prepared in writing and a man is selected to do this. None of the meetings occupy more than three days and as the papers to be read and discussed number from 18 to 24, it is of paramount importance that definite time schedules be set for each. As the response to the request for discussion is enthusiastic and quick, no difficulty is experienced in adhering to the pre-arranged program. It should be noted in this respect that a great improvement was noticed in last year's meetings over the earlier ones. While it was necessary during the first meeting at times to call on members to take part in the discussions, it is gratifying to see the interest and enthusiasm now displayed and the readiness of those attending to take the floor and contribute their share to the proper presentation of the subjects covered by the papers.

Meetings Addressed by Experts from Outside

While the bulk of the papers read at the meetings are prepared by men within the railroad organization, it is customary also to invite one or two men outside of the railroad for each convention to speak on subjects on which they are experts and have special knowledge.

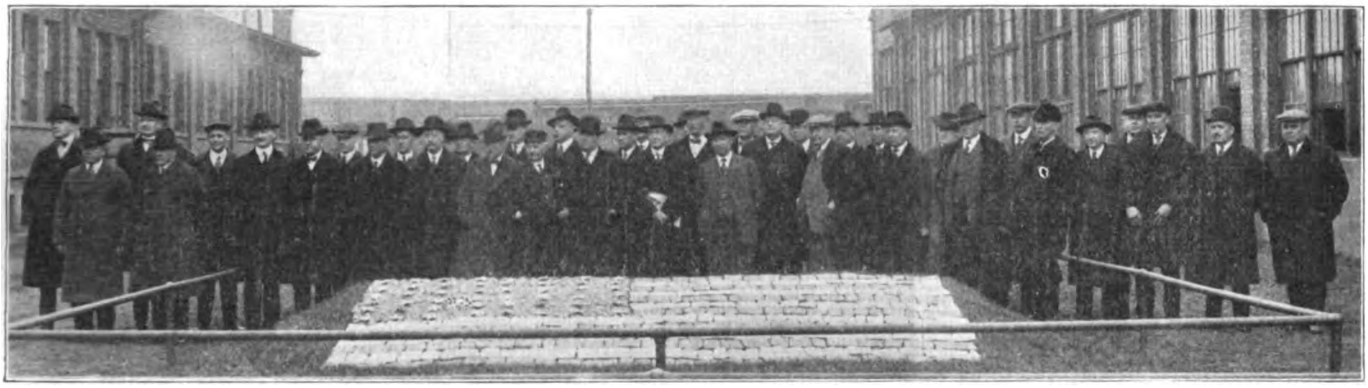
The papers to be read at the meetings must be in the hands of the various chairmen three or four weeks before

the convention so that programs can be prepared and copies of the papers made up for each one attending the meeting. A stenographer is present at the convention and copies of all papers read and discussions are afterwards sent to those present.

As a rule, all meetings are held in a hall set aside for this purpose at Milwaukee shops. A moving picture machine is part of the equipment so that lantern slides or moving pictures may be shown, illustrating the papers. A number of graphic charts of suitable size to be hung on the walls, depicting the various railroad operations of interest to the groups attending particular meetings, are displayed, some giving comparisons with other railroads in neighboring territory and others a progressive comparison of data from year to year.

An instructive exhibition of tools or devices developed during the year at the various shops is also prepared. At the meetings of the master mechanics and car department supervisors there are interesting displays of failed and broken parts of equipment that have caused delays to trains and engines. These may be photographic reproductions, etchings of steel prepared by the test department or in exceptional cases of interest, the failed member itself.

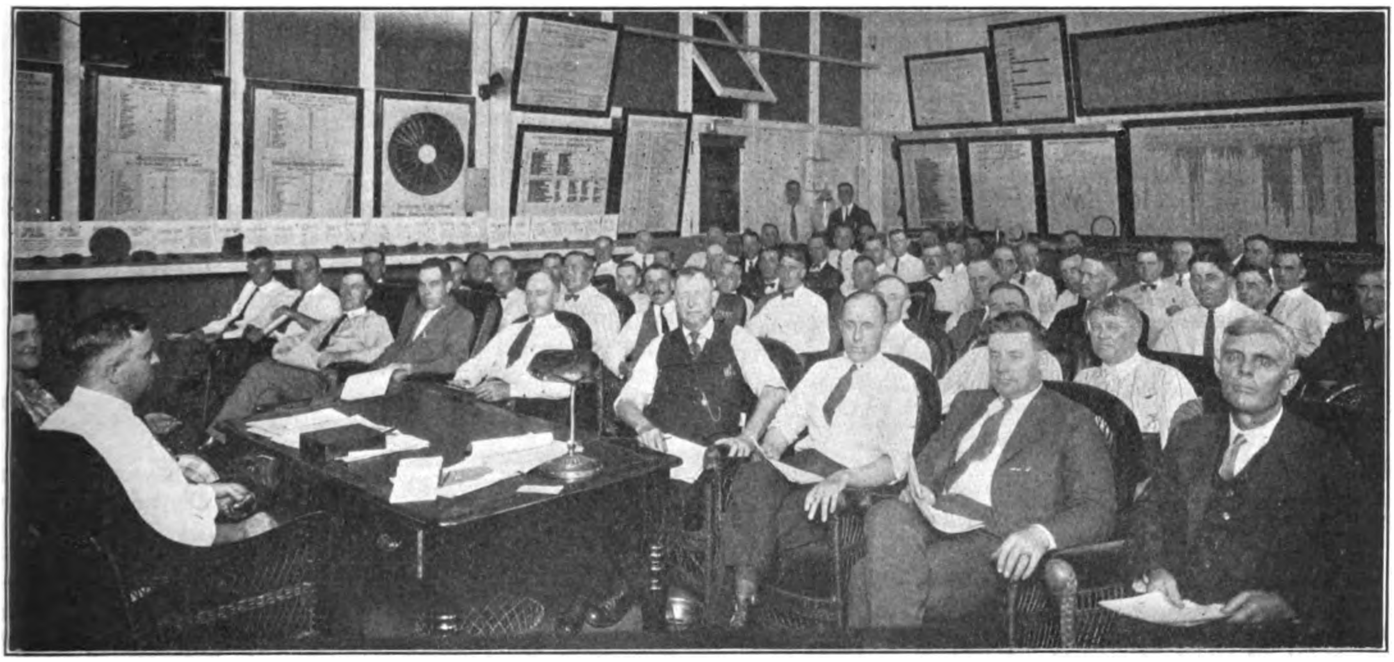
In order to stimulate the interest of the supervisory forces in the various phases of the operation of the railroad, statements and statistics giving concisely and briefly the costs and expenses of the elements of performance in which they are most interested are compiled in booklets which are issued monthly. Comparative tables are also included on engine and train performance, both comparative by divisions as well as with neighboring roads. Based on the standing of the individual divisions in respect to such vital items as cost of locomotive repairs, enginehouse expense, fuel, lubrication and engine failures, a monthly efficiency rank is established and tabulated in the C. M. & St. P. monthly publication.



C. M. & St. P. Car Department Supervisors Attending the 1921 Staff Meeting

Annual Prizes Awarded

To promote competition and effort among the various roundhouse points and car repair shops still further, annual prizes for a first and second place in the locomotive and car departments are given to the points which has shown the greatest progress during the year in maintaining the cleanest premises and having the most efficient and economical operation. A number of the mechanical department officers and special men whose duties take them over the road at frequent intervals have a vote in regard to the awarding of the prizes.



1923 Meeting of C. M. & St. P. General Foremen

The prize consists of a bronze tablet bearing the official monogram of the road and the words: "Greatest Improvements—Best Operation—Cleanest Facilities," besides the name of the station and whether it is first or second prize. The staff meetings of the master mechanics and car depart-

ment supervisors are made the occasions of the presentation of the prizes to the foremen in charge at the winning roundhouses or shops, who are invited to attend the meeting. The presentation is generally made by the general superintendent of motive power.

The holding of these staff meetings is an institution on the C. M. & St. P., now five years old and it is the unanimous opinion of all concerned that the benefits derived from them, both by the individuals attending and by the railroad as a whole, have in innumerable ways repaid the expense and possible inconvenience involved in taking supervisors from all over the system away from their duties for a few days. That the management appreciates the good accomplished through these annual gatherings, is indicated by the effort of some officers always to be on hand to welcome the men and address them on the problems confronting the management or indicating along broad lines the direction of effort that should be made during the coming year.

Each Year Shows Improvements in the Meetings

The annual staff meetings are now well established and as each year comes around a distinct improvement is noticeable both in the character of the papers presented and in the value of the discussions and the exchange of ideas on the subjects presented. In assigning a paper to a man to be read at the meeting of his associates, an appeal is made to his pride and he is going to give the best there is in him and if he is lacking in knowledge on the subject, he will immediately apply himself to acquire all that he can within the limits of his resources. As the meetings are now organized, they have created a medium for making the accumulated experience and knowledge of the supervisors of the mechanical department available by a full and free discussion of practices and policies of the department. The feeling of friendly competition and helpful co-operation, instilled in all who have had the privilege of attending the meetings has been of great benefit to the whole organization. The results are shown in the records and performance of the various branches of the mechanical department.

Master Mechanics' 1924 Program

To show the number and kind of subjects treated at one of the annual department staff meetings the program for the 1924 meeting of the master mechanics is given below:

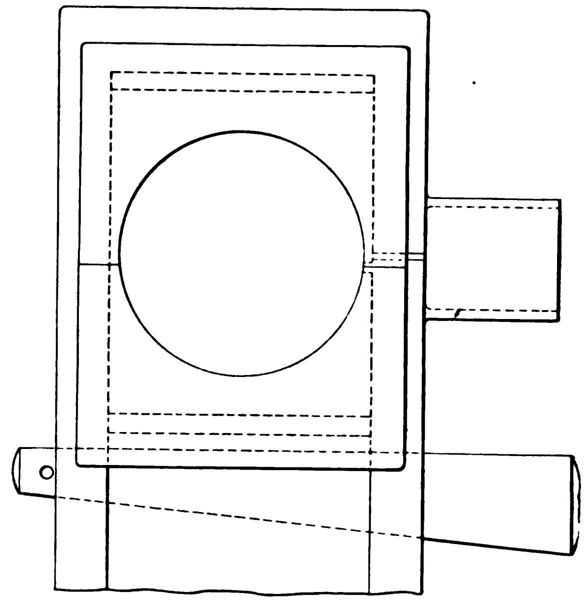
Subject	Assigned to
1—Store delivery in shops and roundhouses	J. A. Anderson.
2—The best method of insuring better relationship and co-operation in our organization	W. Joost.
3—The proper method of handling locomotives between classified repairs in order to obtain the prescribed mileage	P. T. O'Neil.
4—Power plant economies and steam losses in roundhouses	H. W. Williams.
5—The effect circular letters have in increasing and decreasing the cost per locomotive mile	E. W. Hopp.
6—Advantages and disadvantages of running engines over two or more divisions; what difficulties are encountered and actual savings made	F. P. Miller.
7—What can be done to reduce preventable accidents	C. L. Emerson.
8—Departmental co-operation	G. Lamberg.
9—Importance of investigating and promptly reporting engine failures	J. W. Phillips.
10—Problems confronting the mechanical department in congested terminal operation	P. L. Mullen.
11—Co-operation between master mechanics on adjoining div.	H. G. Dimmitt.
12—What is the best system to put into effect for checking the different accounts and seeing that each division is getting the credits and charges due them, at the earliest possible time, so they could be checked and gone over in order that each master mechanic will know what his costs are	H. E. Riccius.
13—Are we receiving the service from our locomotives that should be expected?	R. W. Anderson.
14—Better inspection of locomotives arriving at terminals and what inspection they should receive before being dispatched	T. McFarlane.
15 Causes of flues pitting and what methods can be employed to reduce this trouble	C. H. Koyl.
16—Maintenance of electric locomotives on long runs as compared with shorter runs and what effect it has on lubrication	E. Sears.
17—What system can be devised for a more satisfactory and economical method of handling engine supplies	G. E. Passage.
18—The equipment and facilities needed for the proper maintenance of electric locomotives	J. A. Wright.
19—Federal law requirements affecting locomotive operation	A. W. Novak.
20—Comparison of electric locomotives and steam locomotives	F. Rusch.
21—Accounting	P. G. Winter.
22—Proper inspection and maintenance of locomotive air brake equipment with particular reference to federal requirements	J. Elder.
23—Method of selecting supervisors and inaugurating a system of training men for the various positions before putting them on the job	G. P. Hodges.

An Epidemic of Locomotive Troubles

By F. M. A'Hearn

It is not uncommon to hear so-called epidemics of locomotive troubles discussed in a manner that connects their existence with some unaccountable cause. While it is true that at times some one particular part of a number of locomotives may give trouble, it is also true that these troubles are in most cases traceable to a long interval of good service from the same parts. During an easy period of maintenance, there is a tendency to become careless and to permit conditions to develop that sooner or later cause trouble.

A prevalence of back end main rod brasses heating indicated, in one case, that the pin grease was of lighter quality than that previously used. Investigation proved that the lubricant was the same as had been used for a considerable time. The evidence against the grease was that it worked



Detail of Rod Brasses Showing How the Dividing Line Has Advanced Beyond the Center

out between the strap and the brasses which was taken as proof that the grease was at the bottom of the trouble in this particular case.

An examination of some of the brasses disclosed an unexpected reason both for the heating and for the lubricant appearing along the outside of the straps and brasses. In reducing the back end brasses workmen would machine the required amount off the front half of the brass, repeating the operation from time to time until the dividing line between the halves was advanced somewhat forward of the center of the grease cup, as illustrated, and beyond the hole from the grease cup to the inside of the strap. A small amount of grease would pass between the strap and the brasses and finally reach the pin, but not in sufficient quantity to lubricate the parts properly.

Enlarging the opening in the rear half of the brass to register with the grease hole through the strap was sufficient to check the trouble. An observance of the proper practice in closing brasses completed the cure.

Exterior View of Apprentice School Room in California

Apprenticeship Methods on the Santa Fe*

Why and How the Work Was Started—General Outline of the Plan—Selection of Apprentices—The Equipment

PART I

RAILWAY managements are realizing as never before the need for trained, skilled, and careful men. Men are more in demand than machines and are much more difficult to procure. The question of men, the right kind of men, men by nature endowed and by training and education specifically fitted for the work they are called upon to do, is the biggest problem the railroads have to solve. This need for competent, efficient men is nowhere more keenly felt than in the shop forces of the mechanical department of the average railroad. Far too many roads have been content to put up with unskilled, untrained, inefficient mechanics, taking no steps to prepare men for their specific needs. A few pioneers have paved the way and by the results secured have shown conclusively what may be accomplished by proper selection, education, and training of apprentices in the various mechanical trades.

It is refreshing to know that railway managements are awakening as never before to the need for skilled, all-around mechanics and to the results that may be accomplished by training and developing these men. A number of railways have recently inaugurated modern up-to-date apprenticeship systems to prepare men for their particular needs. Managements of other roads are making searching inquiries and seriously going into the subject thoroughly. It is encouraging to see the growing interest in this important subject. The modern apprenticeship system is without doubt the most promising specific for the alarming shortage of skilled labor that has confronted industry during the last two decades. From the experience of the roads which have gone into this subejct and given it a thorough trial much may be learned, many conclusions may be reached, and much help may be received.

* This is the first of a series of four articles on this subject. A general outline of the contents of the remaining articles in the series will be found in the last paragraph of this article.

Santa Fe Apprenticeship System Has Proved Its Worth

In view of the awakened interest in apprenticeship training, a description of the apprenticeship work on the Atchison, Topeka & Santa Fe will be of particular interest at this time. The Santa Fe has maintained modern apprenticeship courses for more than a decade and a half, and is now giving instruction to some 2,000 apprentices, filling its shops with men of its own making—skilled mechanics trained for the road's particular needs, familiar with its methods and practices, loyal to its officers, and intensely interested in carrying out the policies of the road.

The apprenticeship system on the Santa Fe has long since passed the experimental stage. It has gone through good years and bad, through prosperity and times of depression, the results accomplished more than proving its merits and justifying the wisdom of its promoters. The management of the Santa Fe would no sooner think of doing without its apprenticeship system than of doing without its power plants or its tool rooms. The smoothness with which this apprenticeship system has operated, and the way it has been co-ordinated with all departments is an unanswerable argument as to its practicability; and the unusual efficiency and work performed by the apprentices themselves makes it an immediate financial asset.

Origin of Santa Fe Apprentice Department

A general description of the history and organization of the department will be given in this article. In succeeding issues will appear a detailed account of the methods used both in the school and shop instruction, together with other features pertaining to the training and developing of these young men. The apprenticeship system of the Santa Fe had its beginning when the road was in need of men. Not finding a sufficient number of skilled mechanics available

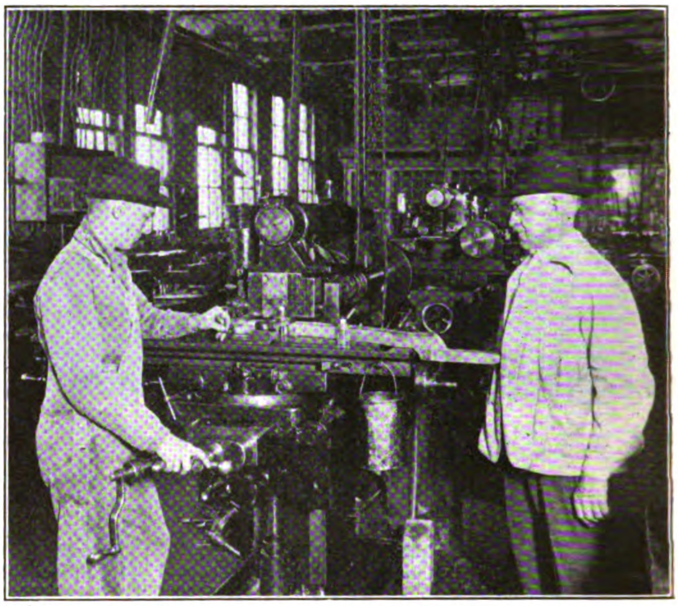
for its shops and engine houses, the management decided to make them from the young men in their midst.

In the summer of 1907 John Purcell, then superintendent of the Topeka shops (who, years before had maintained at his personal expense a little school at the division point where he was then located) and Frank W. Thomas, then engineer of tests, were appointed a committee to investigate methods used by other roads and in manufacturing plants, and to make recommendations as to a plan by which the necessary mechanics would be developed for the various shops and engine houses. In line with their recommendation it was decided to establish a thorough apprenticeship system with a view to training the young men employed, not only to competency and skill in mechanical arts, but also to loyalty to the railroad, to interest in its business and to familiarity with its standards and methods.

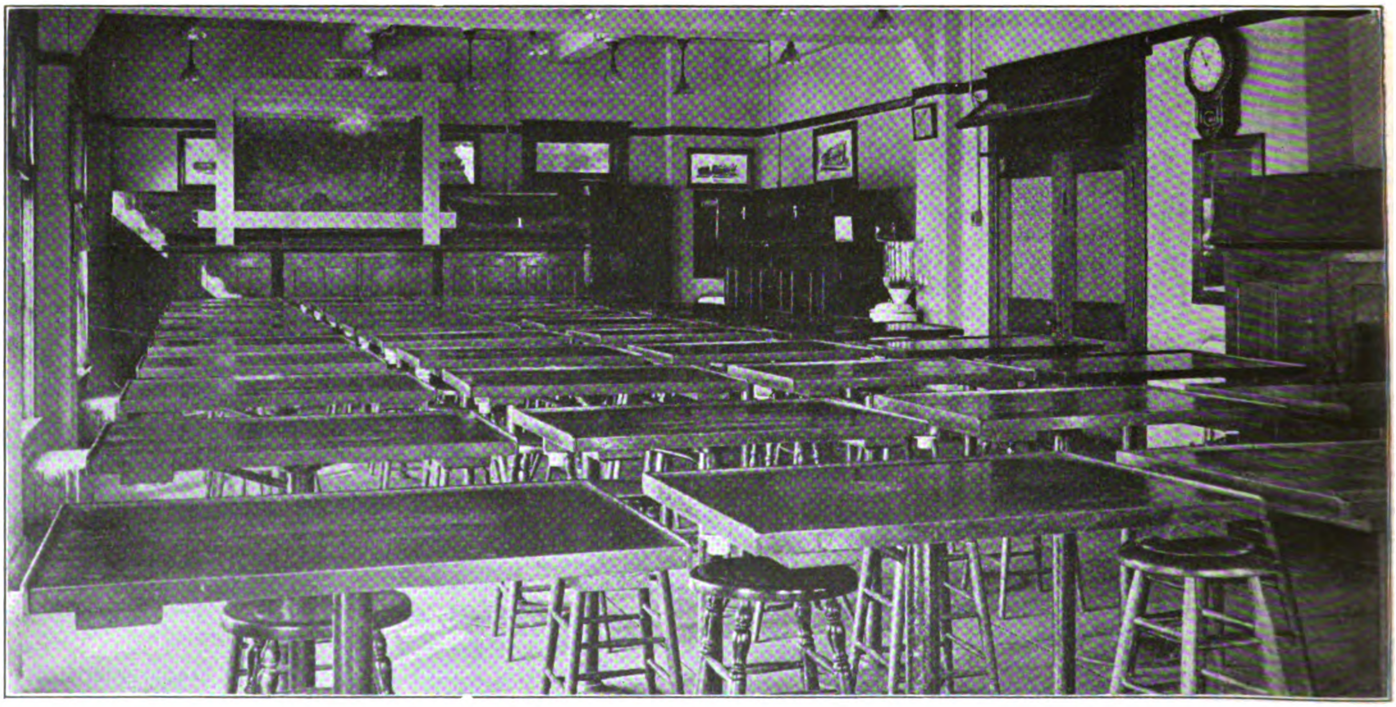
Supervisor of Apprentices Appointed

By September 1, 1907, this resolve had taken the form of the appointment of a supervisor of apprentices, whose especial and exclusive duty lay in overseeing this work and in organizing the staff, general and local, and planning for the prosecution of this work at all the principal shops. He was assigned to the staff of the assistant to the vice-president in charge of mechanical operation and given charge of all matters pertaining to apprentices. He immediately organized the department and established apprentice schools at the larger shops, soon extending these to all the division points on the system. He maintained a central office wherein all lesson sheets, problems, etc., are prepared and from which all supplies for the various schools are furnished. He approves apprenticeship indentures covering the employment of all apprentices and jointly approves with local officials the appointment of all apprentice instructors. In his office is maintained a record of all apprentices and apprentice graduates. From his central office he directs the management of the various schools throughout the system, visiting each school frequently and seeing that all instruction is carried on systematically. He keeps in close touch with local shop officials, securing their full and hearty co-operation. The supervisor of apprentices and his immediate office force are on the payroll of the vice-president of the road. The apprentice instructors are on the payroll of the local master mechanic or superintendent of shops and report jointly to the master mechanic and the supervisor of apprentices.

In any successful apprenticeship system, some one person must be in charge and be held responsible for the proper carrying out of the program of apprentice training. Otherwise, as in any other scheme without a responsible head, but little will be accomplished. No worth-while movement will run itself. There must be a guiding hand, a leader to inspire and direct his forces and to secure the necessary support and co-operation from other departments. Much of the success of the apprenticeship work on the Santa Fe is due to the personality and ability of the supervisor of apprentices, Frank W. Thomas, who has had charge of this work since the organization of the department, and who by virtue of his practical and technical experience, his intense



Instructing Apprentice in Tool Room on Milling Machine Work



Interior View of Modern Apprentice School Room Showing Desks, Cabinets, Etc.

interest in, and understanding of boys, his pleasing personality and popularity with officers and men of all departments, his ability to organize and boost for his department, has been particularly fitted for organizing and carrying on this important work.

Support of Management

It is also essential that the plan of training have the unlimited support and backing of the management. This, the

The Atchison, Topeka & Santa Fe Railway Company

APPRENTICE APPLICATION BLANK

To be sent to Supervisor of Apprentices

Mr. ....19...
Superintendent Shops or Master Mechanic.

....

Dear Sir:

I respectfully submit my application for position as .... apprentice in your shops at ....

My full name is ....

Local address { Street No. .... County .... City .... State .... Telephone .... }

Age ..... Date of birth .... Place of birth ....

Hair .... Eyes .... Complexion .... Height .... ft .... in. Weight ......

Number of years I attended common school .... Where ....

Number of years I attended high school .... Where ....

Grade or class completed in school ....

Evening classes attended or correspondence courses taken ....

Reason for leaving school ....

Number of years since leaving school ....

Occupation since leaving school ....

Former service with Santa Fe ....

Name of parent or guardian ....

Address of parent or guardian { Street No. .... County .... City .... State .... Telephone .... }

Relatives in service of company { Name .... Relationship .... Occupation .... }

☞ Applicant will please leave the rest blank.

Recommendation of Apprentice School Instructor ....
(Apprentice School Instructor)

Recommendation of Apprentice Shop Instructor ....
(Apprentice Shop Instructor)

Commenced apprenticeship ....

Approved: ....
Superintendent Shops or Master Mechanic.

Application Form for Apprentices

apprenticeship system of the Santa Fe has at all times had. Mr. Purcell's paper on apprenticeship before the last meeting of the Mechanical Division of the American Railway Association is a fitting testimonial to the results accomplished by this training system and to the support and backing the apprentice department receives from the higher officials of the company. In fact, everyone on the road, from the president down to the humblest employee, is a booster for the plan of apprentice training. Without such support only meagre results could be secured.

Three Classes of Apprentices

The accompanying statement shows the number of apprentices employed in each trade at each point. There are three classes of apprentices—regular apprentices, helper apprentices, and special apprentices. The regular apprentices must be between the ages of 16 and 21 and must serve four years; the regular apprentices constitute 90 per cent of the total number. Helper apprentices are those promoted from deserving helpers in the shop; they are required to serve three years. The helper apprenticeship offers an opportunity to a limited number of the more deserving helpers. Special apprentices are men with a technical education who are given a three-year course to furnish them the practical experience without which their technical training would prove of little value in a railway shop.

Selection of Apprentices

Great care is exercised in the selection of all apprentices. They are usually taken from boys living in towns and communities adjacent to the railroad, preference being given to sons of employees. The applicant is examined by the apprentice instructor to test his mentality and his fitness and liking for the trade for which he makes application. The amount of schooling required depends largely on the boy's mentality and the opportunities he has had and the use he has made of them. Since the apprentices are being trained for a lifetime of service, it is deemed well to start with boys of good physique and with a sound body. Therefore, each is required to pass a medical examination given him by a surgeon of the company, this examination being similar to that required for life insurance. In addition to the care taken in the selection of the young men, each must show during the first six months, or probationary period, that he possesses qualifications for learning the trade for which he is indentured.

Securing Applicants

No difficulty has been experienced in securing desirable applicants, most of the shops having at all times a lengthy

No. 1.

EXAMINATION
FOR
APPLICANTS FOR APPRENTICESHIP
(Do Not Mark on This Sheet)

In solving the following problems, show work as well as answers. Please communicate in no way with anyone while at work on these problems. We desire to know just how many of these you can solve without assistance from anyone. Please do your best but do it alone.

1. Add 6789, 9327, 673, 3676, and 6324.
2. Subtract 4884664 from 93897009.
3. Multiply 3794 by 804.
4. Divide 114774 by 37.
5. (a) $\frac{1}{2}$ plus $\frac{3}{4}$ plus $\frac{5}{8}$ equals what?
   (b) [illegible] minus $\frac{3}{8}$ equals what?
6. Multiply $12\frac{1}{2}$ by $18\frac{3}{4}$.
7. Add .3, .33, 333., .333, and 3.3.
8. Divide (a) 3.3 by .3.
   (b) .33 by .3.
   (c) 33 by .3.
9. If an apprentice works 9 hours per day at $27\frac{1}{2}$ cents per hour, how much would he earn during a month in which his total time was 216 hours?
10. If a boy operating a cotter key machine can make $2\frac{1}{2}$ dozen cotter keys in $1\frac{1}{2}$ minutes, how many could he make in $1\frac{1}{2}$ days of 8 hours each, working at the same rate?

Typical Examination Questions for Applicants for Apprenticeship

waiting list. These applications are secured through the medium of the older employees in the shops, through the apprentices themselves who advertise the opportunities and good treatment given them, through articles on apprenticeship appearing in the public press and railway magazines, through addresses on subjects relating to apprenticeship systems by members of the apprenticeship department and other railway officials before high schools or public gatherings, through keeping in touch with local school authorities and through the personal contact of the instructors with the apprentices and their acquaintance. The scheme itself is its own

best advertisement. Everyone connected with the road knows of the thorough training given apprentices and of the opportunities offered for promotion; consequently the most desirable boys in the community are attracted to these courses.

There have been a number of cases where officers of other roads and of railway supply companies, knowing of the efficiency and thoroughness of the system of training given, have sent their sons to serve apprenticeship on the Santa Fe, and to take advantage of the training given apprentices and the opportunities offered graduates of these courses.

Apprentices Instructed in School and Shop Work

The plan of training consists of two co-ordinate branches, one known as school instruction, the other as shop instruction, each correlated with the other. There is a shop instructor—a skilled mechanic, a boy-loving man—for each department, or one for each 25 apprentices. Schools of instruction have been established at some three dozen points on the road, extending from the Great Lakes to the

The Atchison, Topeka & Santa Fe Railway System
REPORT OF APPRENTICE DEPARTMENT
Showing Number of Apprentices in Each Trade, Each Point
MARCH 31, 1924

SHOP	Machinists	Boiler Makers	Blacksmiths	Sheet Metal Workers	Electricians	Pattern Makers	Upholsterers and Silver Platers	Painters	Coach Carpenters	Freight Carmen	Specials	Total	Total Previous Month
Topeka	90	26	6	24	7	2	5	15	58	102	13	348	362
Chicago Car Works										14		14	14
18th St., Chicago					1				1			2	2
Corwith	8	2										10	10
Shopton	30	2			1					37	6	76	79
Argentine	31	4	1	4	2			1		32	1	75	78
Topeka Roundhouse	2	1										3	3
Emporia	8	5		2	1					3	1	20	20
Ottawa										51		51	51
Chanute	15	6	1	1						9		32	32
Newton	23	10	1	2	1					22	2	61	62
Florence		1								1		2	2
Strong City	1											1	
Wichita	1											1	1
Arkansas City	16	5		2						9	1	33	34
Guthrie	3									6		9	9
Shawnee										5		5	5
Dodge City	19	4		3						43	1	70	71
La Junta	34	12	2	5	3			3		79	2	140	143
La Junta Roundhouse	8											8	8
Pueblo	6	2								8		16	17
Raton	15	5		2	2					16	1	41	43
Las Vegas	11	1		1						6		19	19
Albuquerque	56	13	3	8	2			3		45	7	137	144
Albuquerque R'dhouse	4	3		1							1	9	9
San Marcial	7	1		1						6		15	15
Deming	4									5		9	10
El Paso	1									5		6	6
Belen	3	1								10		14	15
Clovis	27	7	1	3						10	2	50	51
Wellington	8	1								19	1	29	29
Waynoka	3	1								3		7	7
Amarillo	14	1								8		23	25
Slaton	4	1								4		9	9
Gallup	3									5		8	9
Winslow	14	3		2						10	1	30	31
Prescott	3									1		4	4
Needles	10											10	8
Barstow	2											2	2
San Bernardino	69	4	3	5	4			2	5	99	5	196	198
San Bernardino R'dhouse	3	1										4	4
Los Angeles	7									3		10	10
Bakersfield	6									11		17	17
Calwa										6		6	6
Riverbank	2									3		5	5
Richmond Roundhouse	1											1	
Richmond	17	5		3				1		49	2	77	78
Cleburne	39	15	3	6				9	12	63	4	151	152
Cleburne Roundhouse	4	1		1								6	6
Gainesville	2			1						6		9	9
Temple	10	5		2						12	1	30	31
Brownwood	2	2								3		7	7
Sweetwater										2		2	3
Silsbee	9	2								10	1	22	22
Bellville Yds.	1	1								3		5	5
Galveston	3	2		1						13		19	19
TOTAL M'ch. 31, 1924	659	156	21	80	24	2	5	34	78	857	52	1968	2011
TOTAL Feb. 29, 1924	671	159	21	83	24	2	5	37	79	875	55	2011	
TOTAL June 30, 1922	469	139	25	75	18	1	3	36		583	19	1368	

F. W. THOMAS, Supervisor of Apprentices

Monthly Report of Apprentice Department

Pacific and as far south as the Gulf of Mexico. Where there are a sufficient number of apprentices there is a school for instruction in drawing and mathematics and other subjects kindred to the various trades.

At some points where the number of apprentices does not justify both a shop instructor and a school instructor, one man has charge of both phases of instruction. At other points there is a resident shop instructor for each shop, but the school instruction is taken care of by a traveling instructor, who conducts classes at two and occasionally three points. Traveling instructors also look after both school and shop instruction at the still smaller points. Apprentices at these smaller points serve part of their apprenticeship at the larger shops.

School Rooms and Equipment

The apprentice school rooms are located in the shop yards near the shop buildings in which the apprentices work, but

Form 1211 Standard MPD 10-21 K

Santa Fe.

MOTIVE POWER DEPARTMENT

APPRENTICESHIP INDENTURE

REGULAR APPRENTICE

__________________ (Trade)

INDENTURE, Made this __________ day of __________ 192__

between __________________ Apprentice, Age ______

and his Parents or Guardian, __________________ of the City of

__________________ State of __________________

and __________________ Railway Company.

The Apprentice being desirous of learning the trade, and with the consent of his parents or guardian, is employed at __________________ as an apprentice for the purpose of learning the trade of __________________ for a term of four (4) years divided into eight (8) periods, each period to be represented by an equivalent of 145 eight hour days, or 1160 hours, of service per period.

The Apprentice promises to perform the work of the __________________ craft that is given him to do, obeying the rules of the Railway Company and the instructions of its Officers not in conflict with the rules between the Railway Company and its Employes. He shall not absent himself except on leave of absence from the proper Officer and shall conduct himself as a good and honest Apprentice should.

The Parents or Guardian hereby assent to his employment and will in every way possible encourage and assist the Apprentice to faithfully perform his duties.

The Railway Company agrees to give the Apprentice an opportunity to learn and will endeavor to teach him all branches of the trade, and as a furtherance of this opportunity reserves the right to require the Apprentice to attend Apprentice School provided by the Company, where drawing and other subjects pertaining to the trade are taught.

If the apprentice does not show sufficient aptitude to learn the trade during the first period he will not be retained as an apprentice.

The Apprentice shall not be dismissed or leave the service of his own accord except for just and sufficient cause, before completing his apprenticeship.

If the Apprentice fully complies with this indenture and completes his apprenticeship, a suitable Certificate will be awarded him.

(Signature of Apprentice) __________________ (Seal)

(Signature of Parent or Guardian) __________________ (Seal)

____

Approved, __________________ By __________________
Mechanical Superintendent

Approved, __________________ Its __________________
Supervisor of Apprentices

Form of Indenture for Regular Apprentices

sufficiently removed to be free from objectionable noises of the shop. Many of the apprentice school rooms have been built for the special purpose for which they are used and are models of convenience and usefulness. The starting of an apprentice school on the Santa Fe, however, has never been delayed by waiting for a suitable building in which to operate the school. Instead, whatever room or building was available has been used. Even a dismantled coach or built-over box car has frequently been used until more suitable quarters could be secured. In general the results accomplished have been so soon apparent that local officials have joined with officials of the apprentice department in securing the erection of a suitable school building. In many cases separate buildings have been erected solely for the apprentice schools. In other cases, the school rooms have been confined to the second floor, the lower floor of the building being used for reading room, or possibly for a shop lavatory.

Apprentices Given Thorough Experience

Throughout the entire four-year apprenticeship, each apprentice pursues a definite schedule of school work and of shop work, nothing being left undone which will better fit him for becoming a master of his trade. Upon graduation

he is given a handsome diploma, and as he advances in his work as a mechanic unlimited opportunities for promotion are offered him, some 250 of these young apprentice graduates now holding official positions on the road, positions from gang foreman to that of division master mechanic.

Subjects for Discussion in Later Articles

In subsequent articles a more detailed description will be given of the methods used in the school room, the methods used and schedule of shop work followed in the various departments of the shops, the manner in which full variety of shop experience is secured, what tools are furnished apprentices and how these are handled. The qualifications of apprentice instructors and the source of their supply will be considered, as well as the records maintained regarding work and qualifications of each apprentice, the manner in which the apprentice boards function, and the activities of the apprentice clubs, including their social, literary and athletic activities. The training given special apprentices will be described and also the training given and opportunities offered the apprentice graduate, the use made of the department in recruiting and developing shop foremen, together with mention of some of the direct and indirect results secured from the carrying out of this intensive program of apprenticeship training.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will prrint abstracts of decisions as rendered.)

Acceptance of Defective Cars on Record

G. A. T. X. tank car 16274 was delivered to the Louisiana & Arkansas by the Mississippi Central at Natchez, Miss., on October 22, 1921.

The condition of this car indicated that it had been in a derailment. However, the inspector of the Louisiana & Arkansas accepted the car from the Mississippi Central on a book record of the defects with a promise from the Mississippi Central foreman that he would furnish him with a defect card at a later date. After a lapse of five weeks the inspector of the receiving line requested the defect card from the inspector of the delivering line. However, the delivering line refused to issue a defect card on this car claiming that if the defect had existed on the car at the time of delivery the Louisiana & Arkansas should have protected itself by securing a defect card covering the damage at that time. It also stated that the interchange record previous to delivery to the Louisiana & Arkansas did not indicate such defects as had been reported as existing on the car.

The Louisiana & Arkansas stated that owing to the physical conditions that governed the interchange of cars by it and the Mississippi Central it was necessary to handle the interchange of cars across the Mississippi River by means of river transfer boats. But in order to facilitate the necessary changes there was in existence at the time a gentlemen's agreement between the local inspectors at Vidalia, La., and Natchez, Miss., that bad order cars accepted and run on book record of defects would be covered by defect card when requested by the receiving line's inspector. Evidence that the car was in a defective condition at the time of delivery was submitted to the Arbitration Committee.

The Arbitration Committee decided that the Interchange Rules do not recognize the acceptance of defective cars on record. If the unfair usage defects existed when the car was delivered to the Louisiana & Arkansas on October 22, 1921, defect card should have been procured at that time.—Case No. 1291, Louisiana & Arkansas vs. Mississippi Central.

Facts for Handling of Exceptions on Bills for Repairs

The Maine Central rendered a number of car repair bills against the Canadian National. Exceptions to these bills were taken from three to five months after they had been received in the office of the Canadian National. The Maine Central claimed that these exceptions should have been handled more promptly and that it should not be required to examine the old records which had been filed as ample time had been allowed for exceptions to be taken before records were filed. It, therefore, declined to check the record and suggested that the Canadian National should be required to pay the bill that had been rendered.

The Canadian National considered that these bills should have been handled more promptly but owing to the shortage of A. R. A. billing clerks it was impossible to have all the bills checked. It stated that the Maine Central in replying to the first letter of instructions had advised that the car service records of the Canadian National were incorrect and that if the cars in their possession had been checked it was found that the cars were not the property of the Canadian National but belonged to another company. It contended that if the Maine Central had checked its records properly, it could have established the proper ownership of the cars and billed the proper companies, as the repairs had been made within the year limit as allowed by Rule 91. It also brought out the fact that the Maine Central had refused to reply in other cases to the first letter of exceptions, although at that time repairs were not outlawed, and that the Maine Central should have gone over its records more thoroughly and rendered a bill to the car owners and not to the Canadian National.

The Arbitration Committee sustained the contention of the Canadian National and decided that the Maine Central should handle all exceptions to conclusion.—Case No. 1292, Canadian National vs. Maine Central.

Furnishing of Repair Material by the Car Owners

The Wabash coal car 29048 was damaged on the rails of the Lehigh Valley. Disposition was requested by the handling line according to Rule 120. On September 29, 1920, the Wabash instructed the Lehigh Valley to make repairs to this car and on November 29, the handling line made requisition of the purchasing agent of the Wabash for two longitudinal sills, two top web plates, two bottom plates and two column castings. The car owner furnished the two column castings and rendered a bill for the material amounting to $11.52 but it declined to ship the other material, claiming that the handling line should furnish goods from their own stock according to Rule 122. The Lehigh Valley claims that this material is not a stock item covered by this rule and should be furnished by the car owner. The Wabash declined to furnish the material in question and the Lehigh Valley purchased it on the open market and repaired the car, returning it to service on April 30, 1924. As the car owner claimed that they were within their rights in refusing to furnish the material, it was referred to the Arbitration Committee for decision.

It was the decision of the Arbitration Committee that under Rule 122 the car owner is not required to furnish the plates and angles in question. Therefore, the contention of the Wabash is sustained.—Case No. 1290, Lehigh Valley vs. Wabash.

The Possibilities of Mechanical Painting

Handicaps Which Have Been Overcome—Protection of Equipment Increased Against Corrosion or Decay

By J. W. Gibbons

ONE of the greatest factors that limits the use of the mechanical application of paint and varnish is the attitude of the men. The full force of the men's organization has always been arrayed against the practice, with the possible exception of its use on rough work, such as trucks, freight cars, etc. In unorganized shops propaganda has been manufactured against it, and the men who have taken interest enough in the work to operate the mechanical equipment successfully have even been ostracized.

It is true that the machines used have also been a factor in assisting the propaganda, some being so constructed that they throw an excessive amount of paint which fills the shop or yard with fumes and pigment-ladened vapors. Another type of machine that has greatly assisted the opposition to the use of mechanical painting, is one that is so complicated that it is continually stopping up and requires the services of an expert mechanic to keep it in operation. There is nothing so disgusting to a foreman as to have his work lined up and going fine, and then have it retarded or entirely disorganized by the failure of the paint machine. I have visited many railroad shops in the east as well as the west and found machines of this type that had been discarded. These costly investments have prejudiced railroad officers against the further expense and trouble involved in installing mechanical painting equipment.

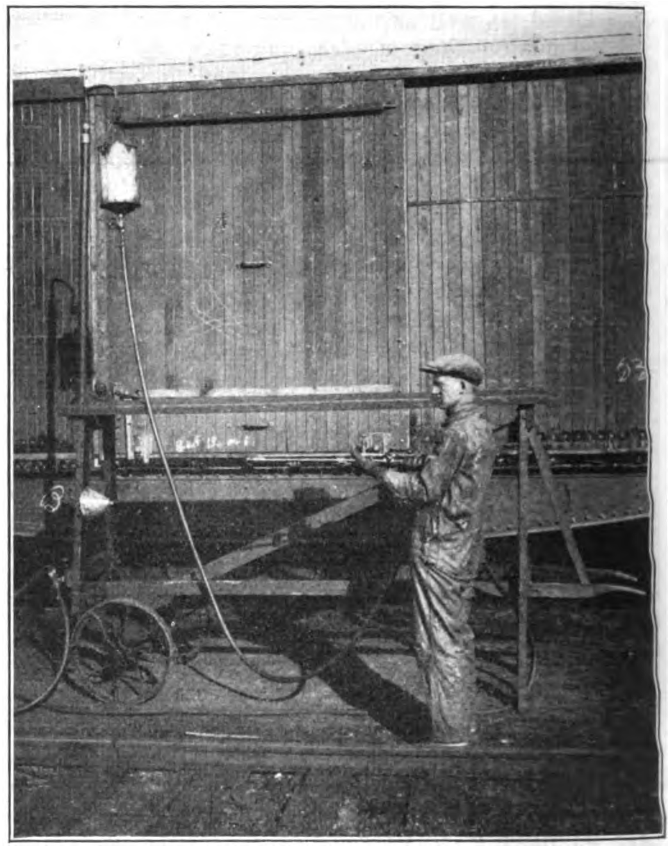
The greatest handicap the writer has had in establishing the mechanical application of paint has been this factor, and tests made of paint applied with the old squirt gun type of machine that really never should have been called even a spray.

Conditions Necessary for Success

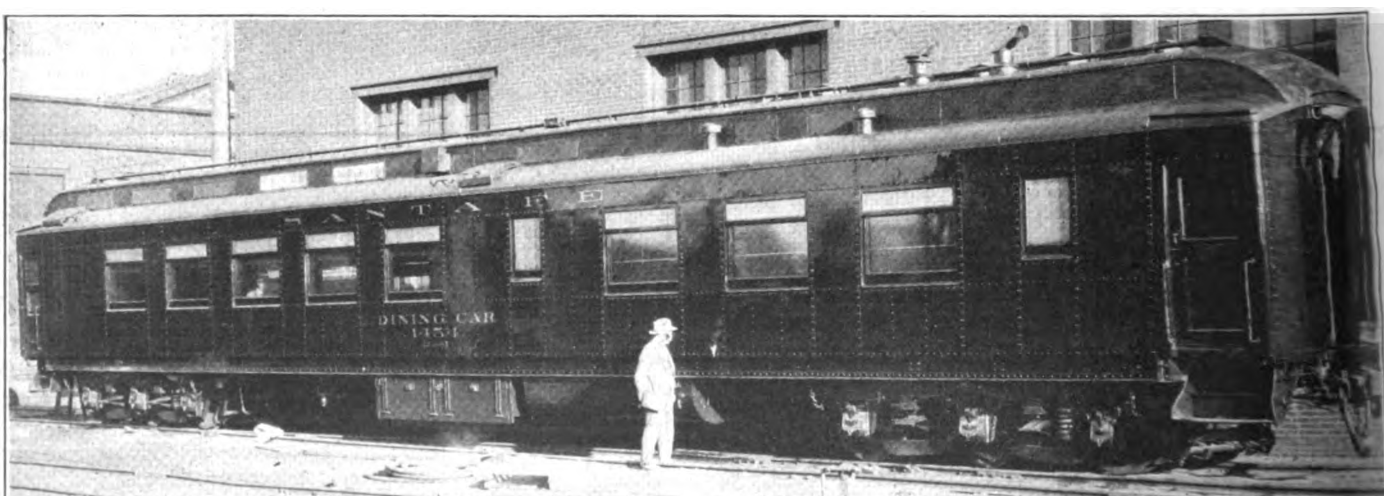
Under what conditions can a successful practice be developed for the general application of the mechanical process in freight car painting?

After having gone through the steps necessary to install a system that is now acknowledged to be successful, the writer believes he is in a position to answer this question. In the beginning was encountered the opposition of the men and the foremen and a negative attitude on the part of many of higher rank. However, necessity, "the mother of invention," assisted materially.

To keep the freight equipment on the Santa Fe even in fair condition, it is necessary to paint approximately 17,000 cars every year. As a matter of fact, the main repair shop

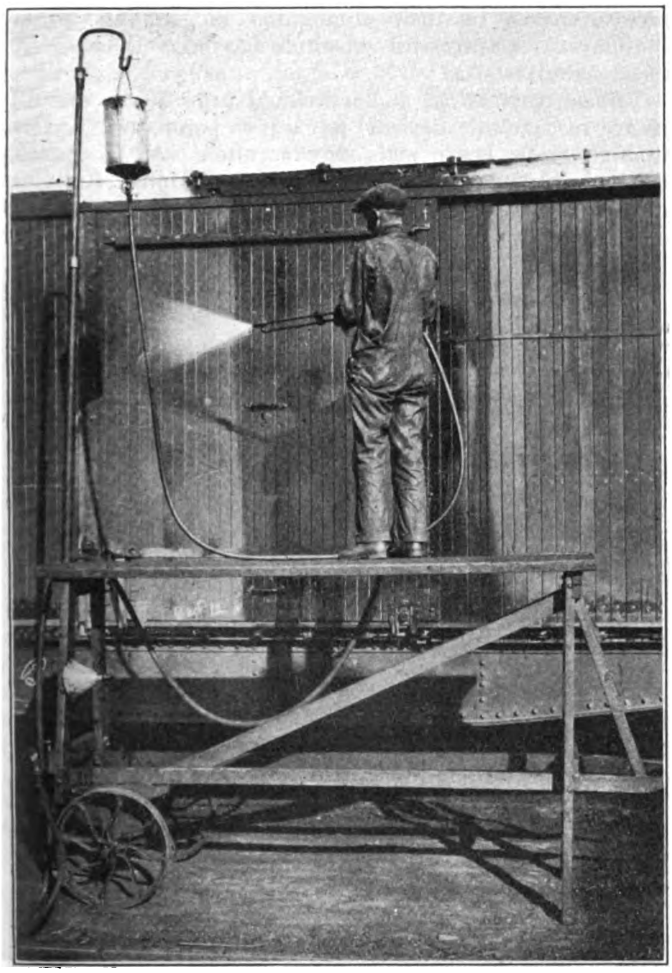


Gravity Apparatus in Operation with Paint Container Hoisted About Half Its Full Height



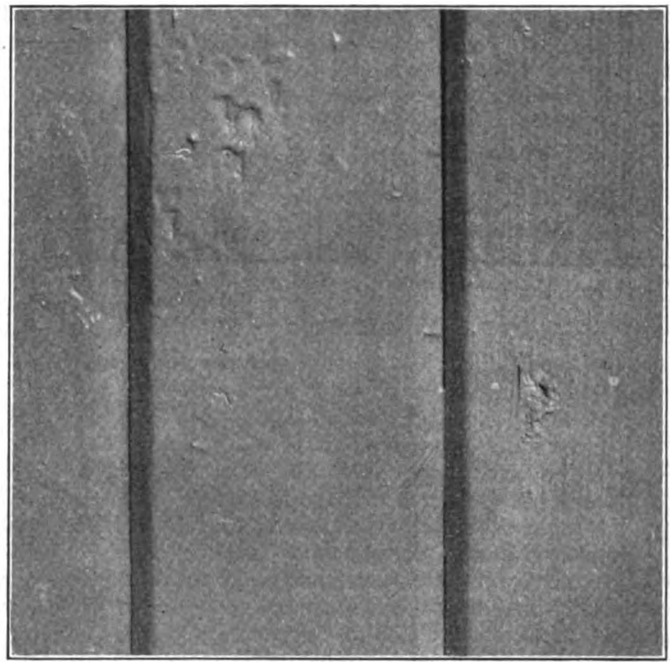
Dining Car After Being Finished by Mechanical Painting

was only painting an average of 160 cars a month and the general practice at all points was to touch up new work and let the car go. The result was a tremendous loss through deterioration of equipment caused by lack of paint protection. In this same main repair shop as many as 485 cars have since been painted in a month, and the average on the entire system has reached the point where adequate protection can be and is given to the freight equipment to maintain it in first-class condition, as well as to advertise for our transportation department favorably.



Gravity Apparatus, Pneumatic Hoist and Portable Scaffold in Service

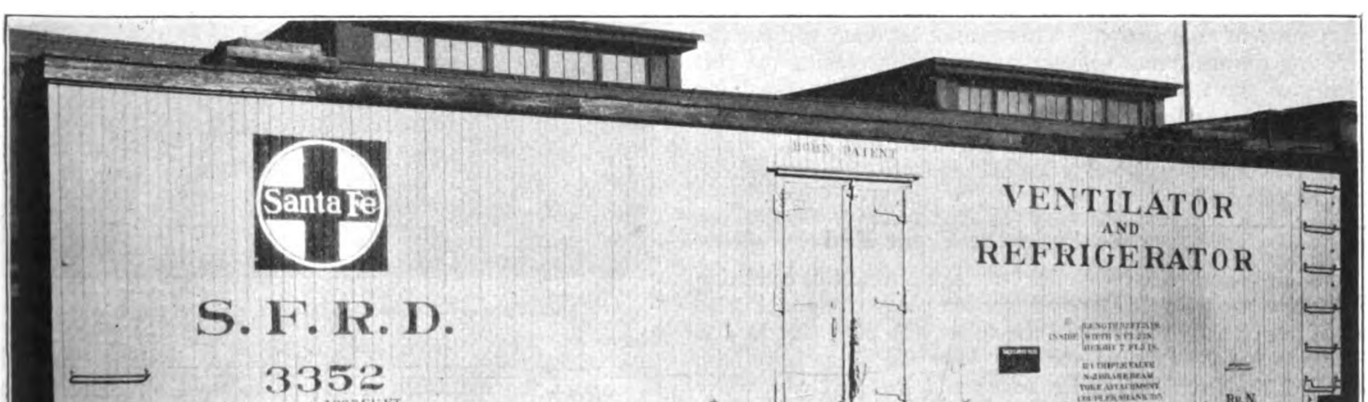
The mist has been eliminated by the use of a gravity paint feed arranged in connection with a portable scaffold. The supply of paint is hoisted to any height necessary to secure sufficient material at the nozzle, where it is atomized by injection of air through a nozzle so arranged as to give the best possible results. The operator is placed as near to the car as he would be if using a brush. The paint is applied evenly and is free from "sags" or "runs." It is carried into crevices and cracks that could not be reached with a brush. This method could be improved in some shops by the installation of a runway to carry the material.



The Surface of the Refrigerator Car Is Free from Lags or Runs

Finishing Passenger Cars

The writer does not believe that under present conditions the mechanical painting process is generally practicable for



This Car Was Finished by Mechanical Painting, Including the Emblem and Lettering

finishing passenger cars because of shop construction and the fact that in some shops all classes of work are done in the same room. The present limitations, however, are not inherent; they can be overcome. No investment will pay greater dividends than the appropriation of sufficient funds to erect shops properly equipped, or for the installation of suction devices in our present shops to carry off the objectionable fumes. We have proved that we have spraying devices that are simple and practicable. With them we have successfully applied primers, loading coats, rough stuff, enamels, varnish and all classes of paint on the interior and exterior of baggage and mail cars, passenger carrying cars, dining cars, business cars, and locomotives. The process is also used in finishing furniture and all classes of work.

The only objection that can be raised against the spray is this: At the convention of Equipment Painting Division of the A. R. A., held at Cleveland last Fall, it was brought up that the spraying of lead, either white or red, might endanger the health of the operator. This objection has already been overcome by their elimination in painting railway equipment. A successful substitute has been developed for these materials.

Private corporations and individual firms are successfully using mechanical devices to apply paint and varnish to high grade house and office furniture and to automobiles, pianos and musical instruments of all kinds. Buildings of all kinds are also now being painted by means of mechanical devices.

Exhaust Nozzle and Front End Adjustment

An Effective Means of Controlling Changes in Drafting Conditions Is Outlined in This Article

By Donald L. Derrom

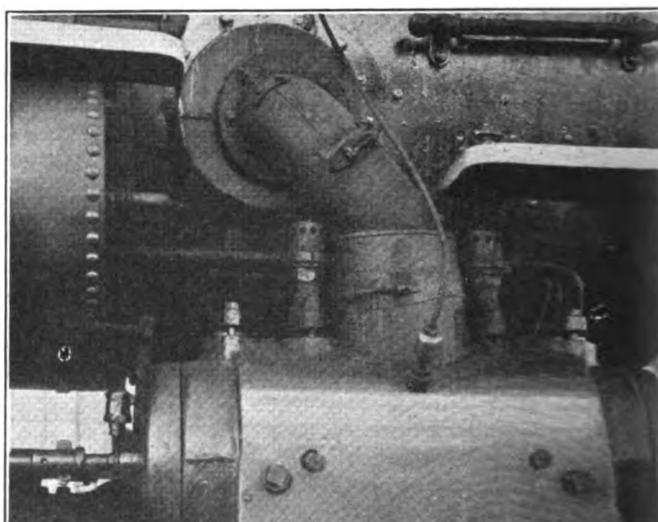
It is generally accepted that the larger the exhaust tip and the higher the diaphragm, consistent with proper combustion, the more efficient and economical the locomotive will be. Due consideration should be given to the accuracy with which standard dimensions for front and adjustments may be established, as well as the proper tolerances or limits to be set within which the adjustments must fall. Experienced men know that it is not always possible to adjust two engines alike, but nevertheless there is no reason why any variation from the standard dimensions should exceed five per cent. Weather conditions are also known to affect steaming conditions to some extent, but the variation should not be more than the above figure, except under very severe operating conditions, such as are encountered in Canada. When the variation exceeds five per cent, there is something radically wrong. However, a careful investigation will often disclose the truth in the most unexpected places.

The problem, then, is to open the nozzle tip and raise the diaphragm as much as possible so as to reduce the back pressure without disturbing the steaming qualities, or interfering with efficient combustion. This cannot be done without decreasing the resistance somewhere else, or increasing the efficiency of the front end by stopping air leaks, or remedying other defects. However, the first and most necessary step is to make absolutely certain that the front end is air tight. Once this is accomplished, a logical sequence of investigations can be followed.

Finding Leaks in the Front End

A simple and effective method of determining this condition is to have a number of tapered wooden plugs made and drive them into the firebox end of the tubes. A plug should also be made for the exhaust nozzle. After the plugs have been applied, the front end and tubes should be filled with water to the top of the stack. This soon discloses any leaks that may exist which cannot be properly determined by a smoke or air test. No engine should leave the general repair shop without this or some equally effective test. Front end leaks can be the cause of wasting from 10 to 30 per cent of the fuel and such a loss is worth looking after.

The worst of leaks are generally found where the steam pipes pass through the smoke arch and where the packing or gland is found to be unsatisfactory or unstable. An effective way to close such leaks is to weld a cylindrical box or collar made of ¼-in. plate, 10 in. or 12 in. larger in diameter than the steam pipes, to the smoke arch. Then weld to this box a cover consisting of two half-annular pieces that have been made to fit tightly around the steam pipes. This cover should only be welded around the circumference to the box and then the two halves should be welded together in such a manner as to contract and close tightly around the steam pipe. The illustrations show such an arrangement on a 20-in. by 26-in.



This Type of Connection Makes an Air Tight Joint

superheated locomotive. This makes an air-tight joint and eliminates the necessity of having to weld anything to the steam pipes. Nor does it interfere with the expansion. The annular pieces should be flanged outward one inch at the steam pipe and they can then be warmed and set in tightly to make up for any roughness in the castings. This cover should be made of either ⅛-in. or 3/16-in. plate.

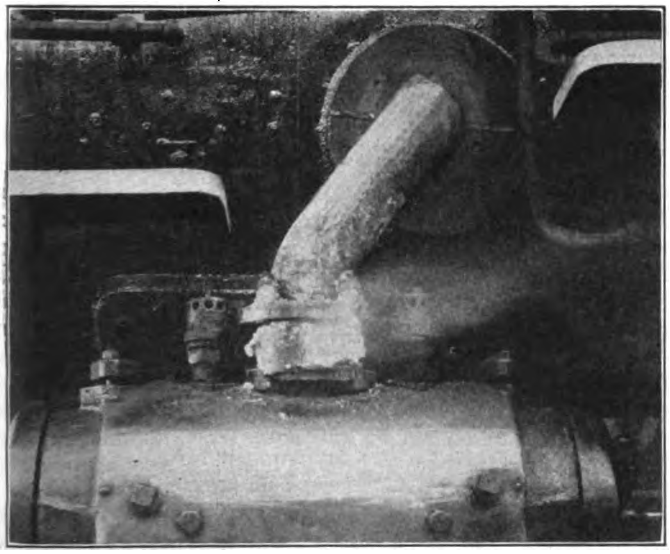
Factors to Be Considered in Testing Front Ends

The function of a front end is to develop sufficient vacuum to overcome the resistance due to drawing the air necessary

for combustion through the ash pan and grates. This air, modified by the products of combustion, passes over the arch, through the tubes, under the apron, through the spark arrestor, and up the stack, through which it is forced by the exhaust steam jet.

These different factors form a train of resistances which culminate at the exhaust nozzle or at the entrance to the stack, and they should all be considered in determining the proper draft adjustment. Some of the factors are more or less constant and are under control, while others are extremely variable.

It is essential in the testing of any apparatus to have a clear understanding as to what factor may be varied or maintained constant, its relative value with respect to other factors, as well as its effect on the final result. When more than one factor is so variable that it materially affects others, difficult complications and uncertain results are liable to follow.



Welded Joint for a Steam Pipe Connection with the Insulation Removed

As the number of variables to be considered increases, so will the difficulty of final adjustment and the formulation of standard rules be increased. The following is a partial list of constant and variable factors involved in the drafting of locomotives. This list will indicate clearly why the problem is a difficult one and why it needs careful study and organized attention. The various factors have been grouped according to the location on the locomotive and the position they occupy in the route of air travel.

Group A—

1 Ash pan air openings .... Constant
2 Grate air openings .... Constant
3 Fire door .... Constant
4 Other air openings .... Constant
5 Dimensions of firebox .... Constant
6 Fuel bed .... Variable
7 Condition of brick arch .... Variable
8 Firebox temperature .... Variable
9 Rate of combustion .... Variable
Total, 5 constant; 4 variable.

Group B—

1 Number, size and length of flues .... Constant
2 Superheater obstructions .... Constant
3 Condition of tubes .... Variable
Total, 2 constant; 1 variable.

Group C—

1 Headers, steam pipes and other obstructions .... Constant
2 Deflector plate; location angle and distance from flue sheet and headers .... Constant
3 Width and height of table plate .... Constant
4 Openings and location angle of netting .... Constant
5 Petticoat or stack flare, if any; location .... Constant
6 Height and angle of apron; range of adjustment .... Variable
7 Draft pipes .... Variable
8 Condition of front end as to leaks .... Variable
9 Shape of nozzle, bridges or bars .... Variable
10 Area of nozzle opening .... Variable
Total, 5 constant; 5 variable.

Group D—

1 Diameter, length and shape of stack .... Constant
2 Position of stack choke with respect to nozzle .... Constant
3 Wind resistance .... Variable
Total, 2 constant; 1 variable.

Group E—

1 Service of locomotive; passenger, freight, yard or pooled .... Variable
2 Steam distribution, squareness of valves, etc .... Variable
3 Condition of piston, valve rings and packing .... Variable
4 Steam pipe joint leaks, unit leaks .... Variable
5 Feedwater heaters .... Variable
Total, 5 variable.

There are listed 26 factors, 14 of which are more or less constant and 12 of which are variable. Each of these has to be investigated and given proper attention in accordance with its relative importance. The place to start investigation, once you are satisfied that the front end is tight, is at the first factor in the train of resistances.

Fireboxes and Grates

The investigator must know if the ash pan has sufficient air. At least 14 per cent of the grate area and as much more as possible should be available, except for those on locomotives engaged in yard service. It requires a large increase in front end vacuum to change the ash pan vacuum a slight amount and relief here has an important effect. The investigator must also know if the right type of grate is installed with the proper air opening for the average coal the road uses.

Better combustion can be maintained with an air door and, as a result, less coal is wasted and less draft required than with the chain door. The volatile part of the coal will be more completely burned off when the door is closed and cold air is not rushing in. The character of the coal has also an important effect on drafting. Thick fires require more draft than thin fires, and clinkering coal requires more draft than a non-clinkering coal. A change of fuel between adjustment tests will often give unsatisfactory results. This is an important matter to watch and have under control.

Tests conducted by the Bureau of Mines have shown that 50 per cent of the air must be drawn up through the fuel bed and the remainder must be supplied over it. This, of course, must be done as uniformly as possible. The source of the air coming in over the fire is through the open door, the holes in the door, hollow staybolts, combustion tubes and holes in the fire due to careless firing. If the combustion conditions are satisfactory with a swinging door, the application of an air door may make it necessary to supply additional openings, such as combustion tubes. The higher the volatile content in the coal, the more necessary it is to take this step.

An arch is not an arch unless it is up solid against the tube sheet. The application of an arch will materially affect drafting adjustments and, if an arch is not replaced correctly when renewing, any adjustments that have been made will be disturbed. An arch is designed to improve combustion conditions and reduce waste and if it is properly installed, it should have the effect of decreasing rather than increasing the draft formerly required. This effect should be brought about in spite of the small added resistance due to restriction of the path of the gases. Variation in the length of the arch will also affect the adjustment.

The installation of an arch, or change in its position, is a variable which materially affects the draft and must be watched and taken into consideration. Another tendency of the arch to reduce the amount of draft required is that it decreases the amount of cinders formerly carried to the front end. This naturally decreases the amount of draft or force necessary to drive them out through the spark arrestor. This is a very important factor, as will be shown later.

The principal objection to the arches being placed solid against the tube sheet is because of the blocking up of the lower flues with cinders. However, this can be eliminated by correct drafting. The application of an arch should permit a wider opening of the exhaust tip.

The maintenance of proper temperatures in the firebox has

a material effect on drafting. Slugging an engine will drop the temperature, as will too much air, particularly on engines that are equipped with chain doors. Clinkering coals, dirty fires and all such details must be carefully watched. An engine adjustment should not be changed without taking the fireman into consideration. Here is a variable that needs careful watching, both before and after adjustments are made. The adjustments should be under the control of one man.

The rate of combustion before and after adjustment must also be kept under control. An engine might steam in one service at a certain rate of combustion and fail in another service. Pooled engines that have to meet two or three different kinds of service conditions must have an average or compromise adjustment.

Flues and Superheater

Resistance through the flues is practically constant, as the amount of draft required is fixed in so far as the tubes themselves are concerned. It should be remembered, however, that any inefficiency in the firebox end has an important influence on adjustments. Sometimes they are such serious handicaps as to make proper adjustment without radical alteration almost impossible. These must be carefully investigated, particularly with respect to the positions of the dead plate, table plate and front end gear. The gases must have a free passage for minimum draft.

Dirty, or leaky flues coated internally with boiler scale are variables that affect front end adjustments quite materially and these must be given the most careful attention. No engine should be adjusted without first determining the condition of the flues and after final adjustment has been made the entire engine should be carefully inspected in order to note the effect of the change.

The Front End

The distance of the deflector plate from the flue sheet and from the superheater headers is an important factor in draft adjustment, as it sometimes affects quite materially the possible degree of superheat. In many cases superheater flues are muffled or damped by deflectors being too close, which reduces the draft and consequently the temperature in the upper flues. Engines have been changed from poor steamers with low superheat to good steamers with high superheat by simply altering the position of the deflectors. Variations in this detail are usually caused by careless boiler makers when reinstalling the front end gear, but they are sometimes caused by defective design.

The table plate must be sufficiently high to allow a free passage of the gases under it: that is, the area under the table plate must be somewhat greater than the total area of the flues. If it is too low, it will have the effect of a low diaphragm apron and the draft will be concentrated in the lower tubes, tending to muffle or damp the upper ones. The same thing applies to the opening between the front edge of the table and the smokebox front. When considering the area under the table plate, the presence of steam pipes, nozzle or other obstructions must also be taken into consideration.

Diaphragms should be made so that they cannot be adjusted too low, but so they can be raised to give an area underneath that is equal to or greater than the total area of the flue openings. The relation between the adjustment of the apron and alterations of the exhaust tip must be clearly understood. When a tip is opened the apron must be raised and vice versa if the fire conditions are to remain the same. Opening the tip decreases the vacuum in front of the apron and, if the apron is not raised to correspond, the fire conditions will be disturbed.

On every class of locomotives there is a definite relation between the diameter of the nozzle tip and the height of the apron. A good way to compare engines is to multiply the diameter of the tip in inches by the height of the diaphragm in inches. By this method a factor can be obtained that will give a rough means of comparing one engine of the same class with another, or with an assumed correct one. For example, assume the tip to be 5 in. in diameter and the height of the apron 20 in., then 5 times 20 will give a factor of 100; or an engine having a 4½-in. tip and a 15-in. diaphragm will give a factor of 67.5, etc. The aim is to get the engine to steam with as high a factor as possible.

Many attempts at opening nozzles fail because of the neglect to adjust the apron to suit the new conditions. The higher the apron is placed consistent with good steaming, the larger the nozzle can be made and a more economical engine will result.

The spark arrestor area cannot be too great and it should at least be large enough in total opening to exceed the area under the apron at the maximum adjustment, because of the increased friction in drawing the gases through so many small holes. Liberal netting area means a larger tip and less vacuum.

The rules for adjusting petticoat pipes go to prove that there should not be any. For example, to increase the draft in the lower tubes, the petticoat is raised, and to increase the draft in the upper tubes it is lowered; that is, its adjustment is exactly the reverse of the apron. To increase the draft in the lower tubes the apron is lowered and to increase the draft in the upper tubes it is raised. Now if the petticoat be placed close up to the stack, the draft in the lower tubes has been increased and of necessity the apron must be raised to increase the draft in the upper tubes. It is evident, therefore, that if the petticoat is not up to the stack, the apron is not as high as it should be. To make a long story short, the stack should have a fixed inside flare or bell, as has been recommended by the A. R. A.

The bad effect of leaks has already been pointed out. Leaks force a reduction of the tip and a lowering of the apron, which must not be tolerated.

Shapes of nozzles can be varied, but unless other factors have failed it would seem that the policy of adhering to the circular nozzle is safest. Bars or bridges should be forbidden, for while they may be effective in some instances, they are too easy to apply and form an easy way of evading proper adjustments. Their use often prevents investigations and development along proper lines. Both enginemen and shopmen should be taught that a small reduction in diameter will make a larger percentage of reduction in the nozzle area.

The Stack

Stack dimensions, as well as the location and size of the choke, are very important, and the stacks should be examined to see that the exhaust is filling them properly. Watching changes in soot deposits and draft action inside the stack after a trip has been made will tell this story quite clearly.

Wind resistance is a factor that should be given attention and investigation as little appears to have been done along this line as yet. A knowledge of this subject might possibly lead to a change in the form of the stack.

Condition and Service of the Locomotive

The service to which an engine is assigned, as was previously pointed out, has an important bearing on drafting. It has an effect on the rate of combustion, temperature and superheat, as well as steam distribution. A superheated engine requires a smaller tip than a saturated engine of the same class because a less volume of steam is used and the higher the superheat the more noticeable will be the effect. Superheat, steam distribution and draft are all very closely allied.

The last to be mentioned, but perhaps the most important, is the human factor. The engineman who has control over the operation of the locomotive, and the fireman who handles the coal, must be considered. Careless steam distribution

while running, slugging, carrying too much water, dirty fires, undetermined blows and pounds, and a hundred and one other factors, if neglected, will have a tendency to bring about wasteful drafting conditions.

A One-Man Job

The most important step in maintaining front end adjustments is to have one man on each division in sole charge of this work. Alterations should only be permitted under his direction. To leave such a complicated problem in the hands of men who are only partially informed is a costly procedure.

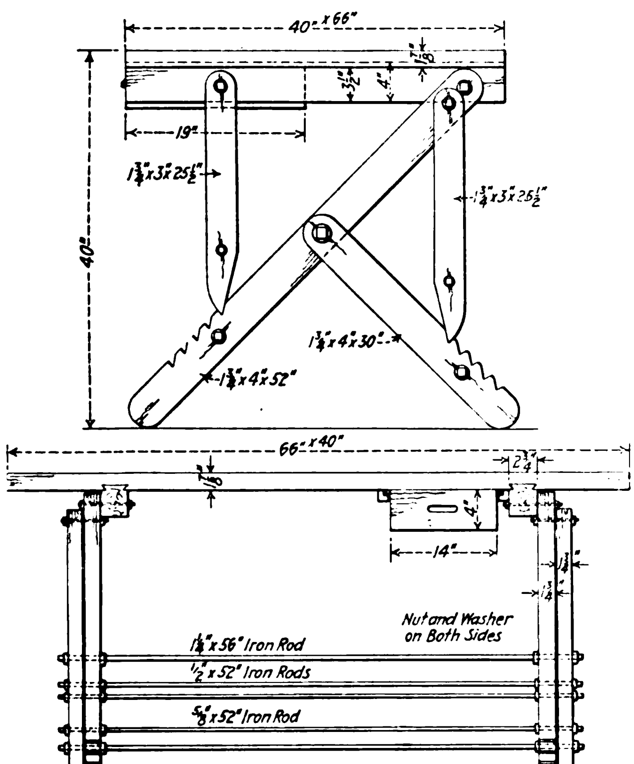
An effective means of controlling these adjustments is to require that any changes in drafting conditions, such as in the diameter of the nozzle tip and height of the diaphragm, the date of arch renewal, the date of last valve setting, and the date of last cylinder packing renewal, be entered on a card, with the signature of the foreman responsible, and the card kept permanently in the cab of the locomotive. Should an inspection show conditions differing from those recorded, an investigation should be made and the person responsible for the unauthorized changes disciplined.

Drawing Table for the Machine Shop

By H. H. Henson

Machine Shop Foreman, Southern Railway, Chattanooga, Tenn.

A drawing table that can be constructed by any mechanic who is handy with carpenter's tools, is shown in the drawing. This table can be adjusted for any angle or height desired. The top is made of white pine 40 in. by



Adjustable Drawing Table for the Machine Shop

66 in., and is equipped with a drawer 14 in. by 19 in. and 4 in. deep. Two braces are dovetailed the entire width of the table, to prevent warping of the top. The legs are secured to these braces by bolts. They are made of oak, or some other hard wood, and are provided with notches so that the table can be adjusted to any angle. The vertical supports are made of 1¾-in. by 3-in. material, pointed at the lower ends to fit into the notches cut in the legs. The legs are made of 1¾-in. by 4-in. material and both the legs and the vertical supports are braced crosswise of the table by iron rods. The table is substantial and rigid in construction and is handy around a machine shop.

A Device for Reseating Cole Pop Valves

Maintenance of pop safety valves has been an important part of shop work ever since the building of the first steam locomotive. It is essential that safety valves function properly. For this reason a great deal of pains is taken to see that they are properly adjusted and that no steam escapes when the valve is seated. The device shown

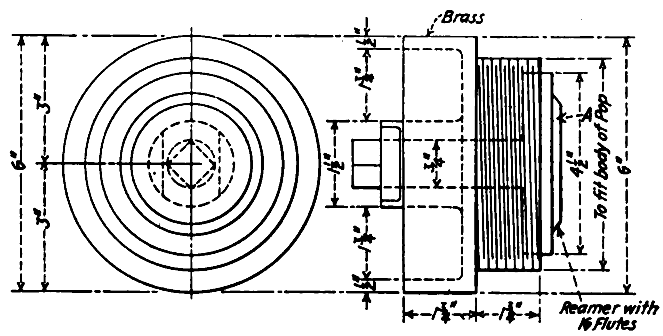


Fig. 1—Sketch of the Valve Body Reamer

in the sketches consists of three parts and is used for reseating Cole pop valves only.

It has been customary, when the seat and valve have become worn, to refinish them on a lathe. This work always

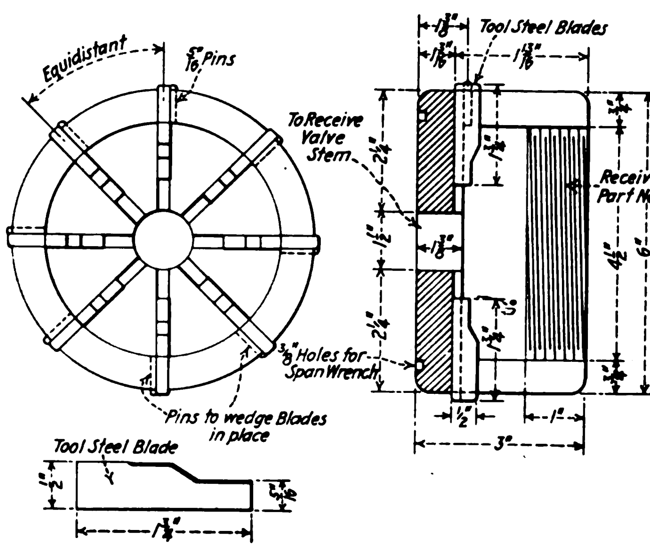


Fig. 2—Sketch of the Valve Reamer and Detail of the Blade

takes considerable time on account of the necessity of having an accurate set-up. However, this device has been designed with the object of eliminating all lathe work and at the same time insuring accurate refinishing of the valve and valve seat in a short time.

The valve body reamer, shown in Fig. 1, is made of brass and is threaded to screw into the body of the valve. A reamer with 16 flutes is fitted to the base, as shown at *A*.

It is turned by applying a wrench to the ¾-in. extension that projects up through the center. The device is operated by screwing the brass body into the valve until the reamer touches the seat. The reamer is then turned by a wrench and is fed downward by turning the brass body until the required cut is taken. This makes an accurate and smooth seat.

Figs. 2 and 3 show the valve reamer and holder used to refinish the worn seat of the valve. The holder shown in Fig. 3 is clamped in a vise. The valve is then placed in the valve reamer with the stem protruding through the 1½-in. hole in the top. The valve reamer is then screwed onto the holder until the blades rest against the valve. The holder functions as a feed during the refinishing operation. A wrench is used to turn the valve until the required cut is taken.

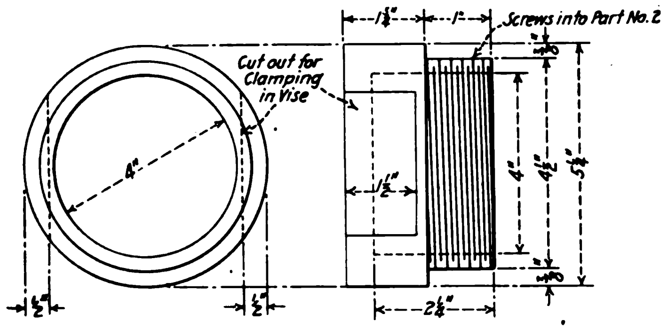


Fig. 3—Sketch Showing the Holder As It Is Clamped in the Vise

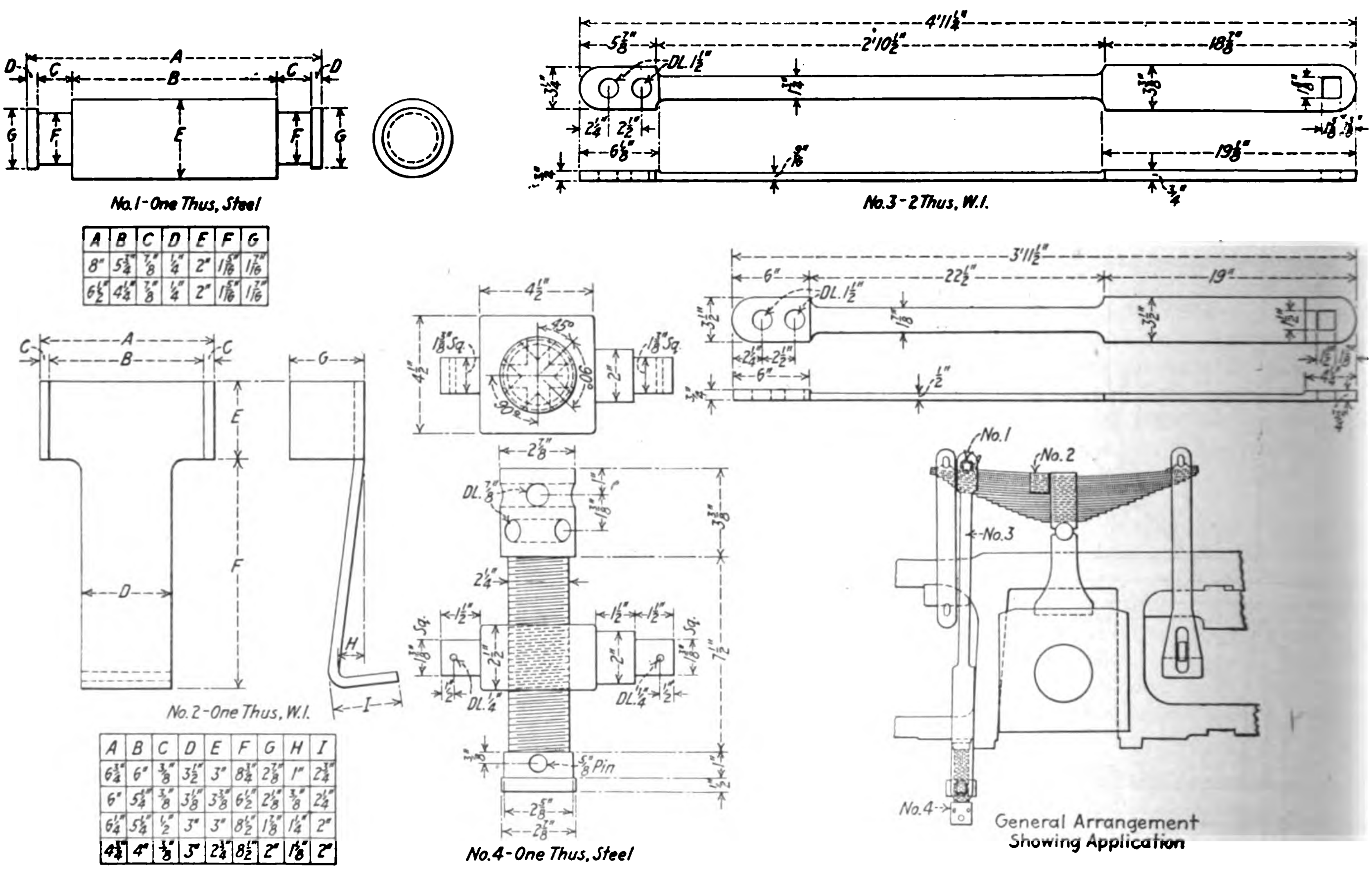
By the use of this device the valve seat and valve may be refinished ready for grinding in 12 minutes.

A Convenient Spring Puller

By E. A. Miller

A CONVENIENT device for pulling down springs so that they may be hooked up at various points is shown in the drawing. It consists of a pair of links, the length to suit the frame and spring around which they go, having two 1½-in. holes drilled at the top for the purpose of giving a variation in length when needed. The lower end of each link has a 1⅝-in. square hole. Detail No. 1, shown in the drawing, is a round steel pin which fits into the holes at the top of the links. It has a collar on each end to prevent the links from falling or sliding off the spring before the device is tightened. The links are placed over the lower pin, which is provided with square ends in which are drilled two ¼-in. holes for cotter pins to prevent the links from slipping off.

The yoke portion of the lower pin is bored 2¼ in. at right angles to its axis, and threaded so as to mate with the jack screw, over which it is put before the short end cap is put on and fastened with a ⅝-in. cotter pin. The opposite end of the screw has a longer end which contains two ⅞-in. holes perpendicular to each other and to the axis of the screw, drilled through one inch from the end. Two more holes are drilled through 1⅜ in. from the first two, and at an angle of 45 degrees to them. This feature provides a hole every 45 degrees into which a pin bar can be inserted in pulling down the spring. Detail No. 2 shown in the drawing is for the purpose of preventing the upper end of the device from sliding towards the spring band when used on curved springs. The method of application is also shown on the drawing.

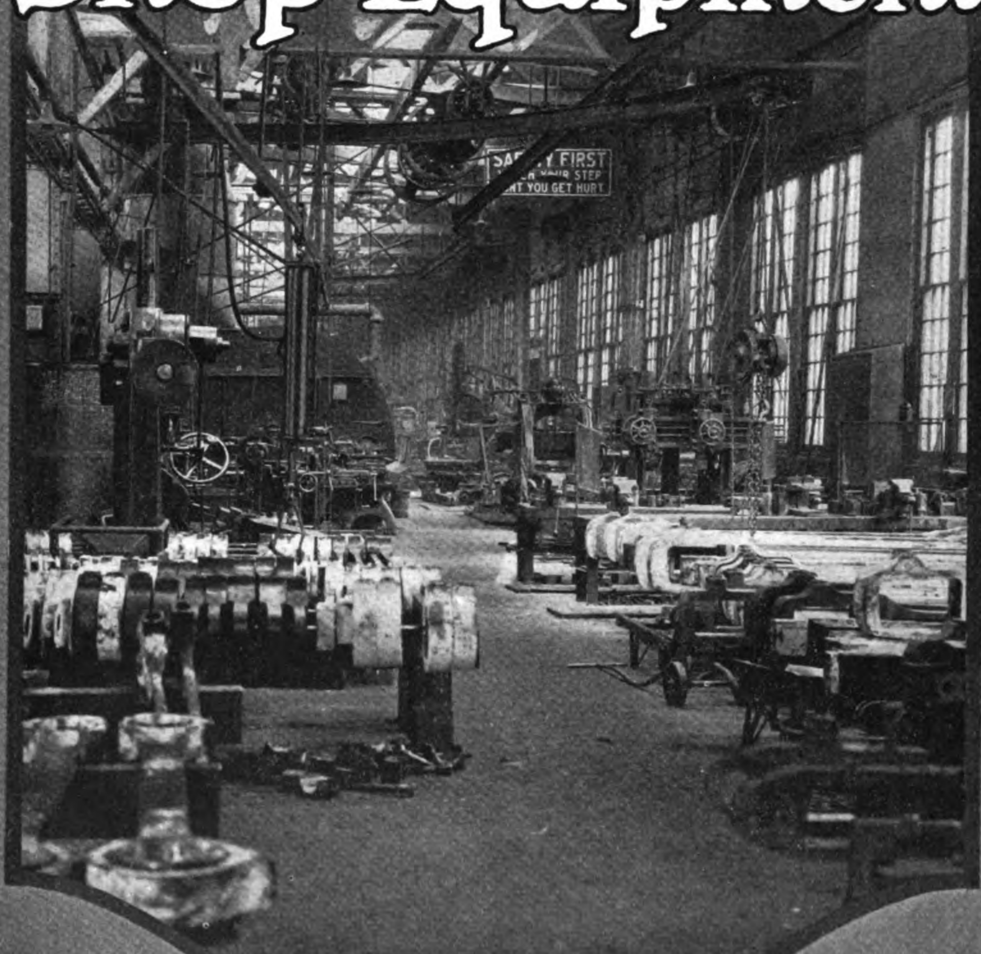


A	B	C	D	E	F	G
8"	5¾"	⅞"	¼"	2"	1 5/16"	1 7/16"
6½"	4¼"	⅞"	¼"	2"	1 5/16"	1 7/16"

A	B	C	D	E	F	G	H	I
6¾"	6"	⅜"	3½"	3"	8¼"	2⅞"	1"	2¾"
6"	5¼"	⅜"	3⅛"	3⅜"	6½"	2⅛"	⅜"	2¼"
6¼"	5¼"	½"	3"	3"	8½"	1⅞"	1¼"	2"
4¾"	4"	⅜"	3"	2¾"	8½"	2"	1⅛"	2"

A Device For Pulling Down Springs When Hooking Up Spring Rigging

New and Improved Machine Tools — and — Shop Equipment



Portable Mechanical Painting Equipment

As the result of several years of development work, the W. N. Matthews Corporation, St. Louis, Mo., has recently placed on the market a portable apparatus for mechanical painting. Care has been taken in the design of this equipment to see that there is a continuous supply of air at a uniform pressure, free from moisture and oil. These units have been designed to handle a wide variety of materials, such as lead and oil or ready mixed paints, mill whites, stains, varnishes, lacquers, enamels and shellac.

In order to meet different working conditions, this company manufactures various types of equipment. Each type consists essentially of an air compressor that is operated by an internal combustion engine, or an electric motor. There is also an air storage reservoir and the necessary paint pots, hose and guns. The assembled unit, consisting of the compressor, driving unit and reservoir, may be mounted upon a portable hand truck, or on a standard truck chassis of the Ford or Chevrolet design.

The illustration, Fig. 1, shows the portable engine-driven equipment with a water-cooled compressor of the vertical

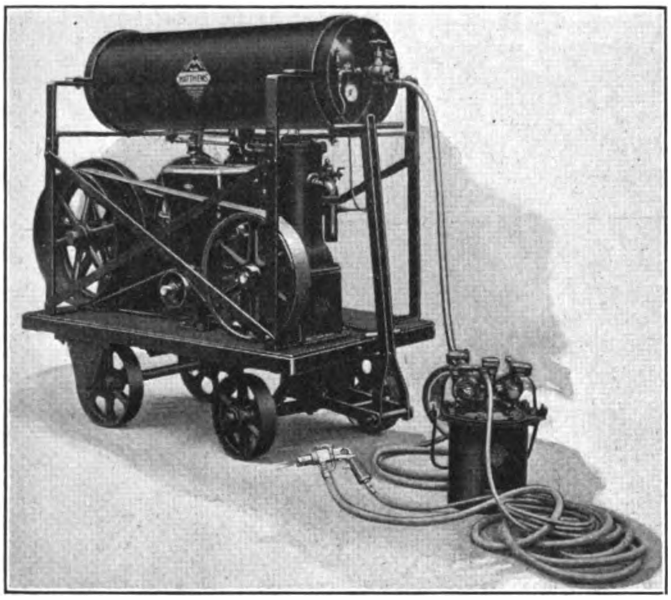


Fig. 1—This Equipment Is Driven by an Internal Combustion Engine and Has Sufficient Capacity for Two Guns

type, fitted with feather valves. The compressor has a capacity of approximately 15 cu. ft. of free air per minute. Special attention has been given to the system of lubrication so as to reduce to a minimum the oil content of the air. In addition to having a safety valve on the air reservoir, there is also an automatic unloader on the compressor to remove the load when the demand for air is less than the amount delivered. The equipment and truck, as shown in the illustration, weighs 1,075 lb.

The horizontal engine is of the single cylinder, four-cycle type, equipped with a water reservoir for cooling, and develops three horsepower. It can operate on either gasoline or kerosene. A belt drive is used between the engine and the compressor to secure proper weight distribution and also to eliminate vibration when it is operated. The electrically operated units, Fig. 2, are practically of the same design, except that a motor is substituted for the engine. If the equipment is mounted upon an automobile chassis, the engine and compressor are direct connected. This provides a simple driving mechanism.

The material container, or paint pot, is equipped with a filling plug, air release cock, safety valve and two diaphragm regulators with gages. One regulator controls the pressure on the material in the pot and the other governs the air supply to the gun. Two containers are furnished, one of 2½ gallons and another of 12½ gallons capacity.

The gun shown in Fig. 1 will handle materials ranging

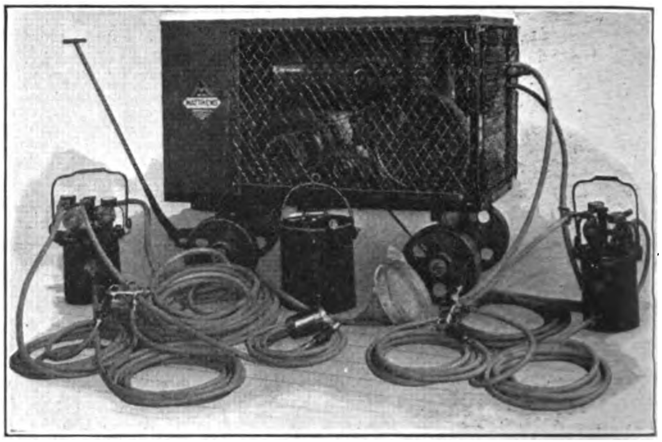


Fig. 2—The Electric Motor Driven Unit Also Is Compact and Easily Handled

from cold water paints up to and including those with an asphaltum base. By adjusting the sleeve at the nozzle, it will deliver a flat or fan-shaped strip with a width from 10 in. to 12 in., or a cone of about 8 in. in diameter. The gun is designed to effect contact between the air and the paint only at the extreme end of the nozzle. This tends to produce perfect atomization of the material. An outstanding feature

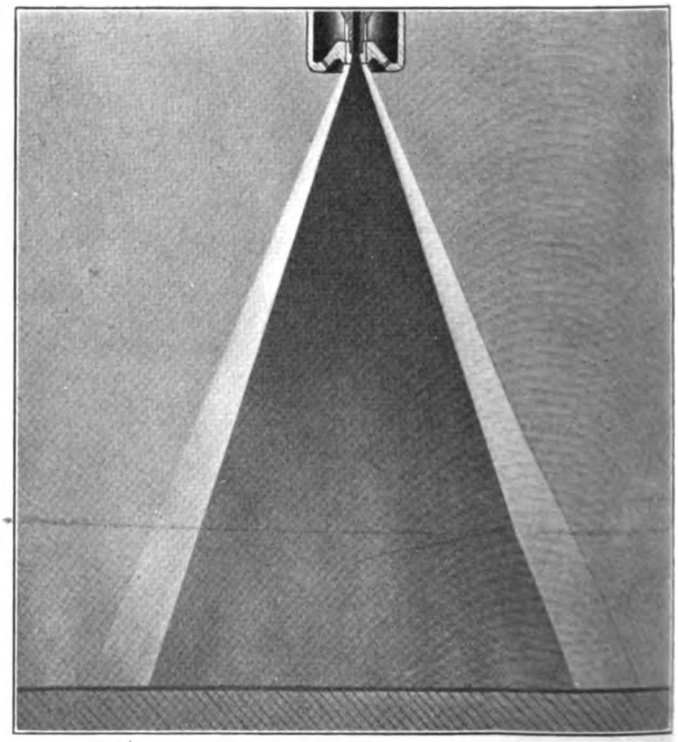


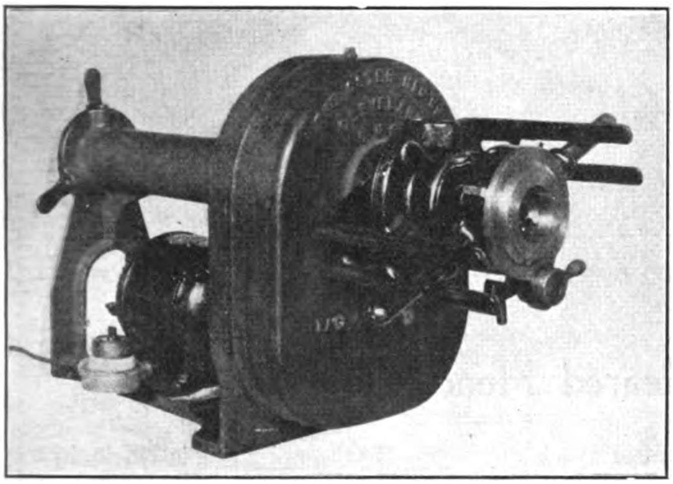
Fig. 3—The Paint Cone Is Surrounded by an Envelope of Free Air

of the gun is the air envelope that surrounds the paint cone. as shown in Fig. 3. The free air in the envelope travels faster than the air in the cone that is laden with paint and the result is that practically the entire quantity of material

is delivered against the surface to be painted, while comparatively little escapes into the air as mist. This produces an economy in the consumption of material, with a cleanliness in operation that equals ordinary brush work. This equipment has sufficient capacity for the steady operation of two of these guns.

Power Driven Pipe Threading Machine for Small Work

A SIMPLE and compact power driven pipe threading machine has been designed by the Oster Manufacturing Company, Cleveland, Ohio, which will thread all sizes of pipe from 1/4 in. to 2 in., inclusive. It has three desirable qualifications: Portability, light weight and capacity for small work in railroad shops and terminals.



The Motor of this Portable Threading Machine Runs from an Electric Light Socket Which Eliminates Extra Wiring

The machine is driven by a 1/3-hp. motor geared to the driving arm, which furnishes ample power to thread all sizes within the range of the machine. The motor is run from an ordinary light socket, which eliminates the necessity of installing extra wiring. The driving arm maintains a zero load speed of 9 r.p.m. and approximately 8 r.p.m. under a load. The motor will drive the regular No. 104½ Oster Bull-Dog die stock, the dimensions of which are 2 ft. 11 in. long, 1 ft. 2 in. wide and 1 ft. 8 in. high. The machine, complete with motor, weighs slightly over 200 lb., which makes it convenient for two men to handle.

The tool is equipped with a built-in scroll chuck and auxiliary centering guide which eliminates the necessity of an extra vise. The chuck and the guide are self-centering and self-locking. The gears are completely enclosed and run in oil, and operate with very little noise or wear. The driving arms, which are necessarily extra strong, are of malleable iron. The chuck jaws and guides are drop forged steel and casehardened.

The machine is simple to operate. The cutter is placed on the pipe in much the same manner as it is when about to thread by hand. The handle rests against one of the driving arms and the machine revolves it. The only attention the operator need give the machine is to tighten it on every revolution.

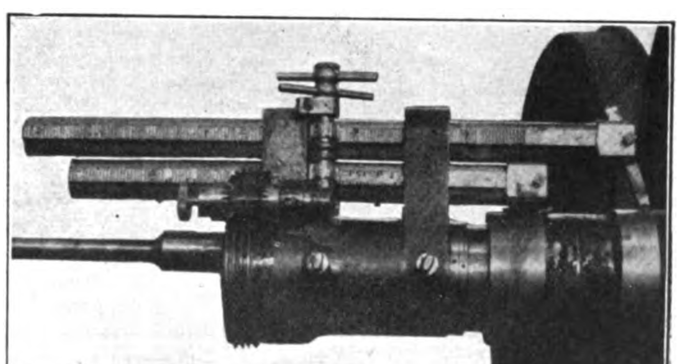
Portable Crank Pin Turning Machine

AN improved portable crank pin turning machine has been designed and patented by C. E. Marsh, Atlanta, Ga. The design of this machine embodies important changes over the types of crank pin machines now in use. It is adapted to use under engine terminal conditions, where time counts in keeping the locomotives in active transportation service on the road.

The principal advantage of this machine is that it will turn two journals on a crank pin at the same time, effecting a saving of one-half the time used by machines that have only one tool bar. The illustration gives a clear view of the arrangement of the two tool bars. These bars are made of tool steel and hardened. The gears are machine cut and hardened and special attention has been given to lubrication. The tool bars are of the automatic, constant feed type, with a reverse, each bar being equipped with an independent speed control. The automatic constant feed with a reverse eliminates gouging in turning and prevents the usual jerk caused when the old-fashioned star wheel bumps against the peg to feed the tool to the work. The tool bars are provided with rapid travel and are moved to, or can be withdrawn from, a cutting position by the operator without having to turn a feed screw by hand.

The operation of the machine is simple. The stationary spindle is fastened to the end of the crank pin, and a rotating cylinder with two tool bars is fed out to the work to be turned. A compensating adjustment is provided to take up the wear on the spindle. It is driven by machine cut gears and is adapted for any air motor of standard make. The net weight of the machine is 126 lb.

The machine has all the equipment necessary to turn all sizes of crank pins and requires no extra equipment. The operator does not have to change from a short to a long tool bar to turn a long crank pin, nor does he have to change a tool bar when half way over a cut to put in a longer bar. The tool bar furnished with the machine will turn up to 19 in. in length without having to stop the machine. The machine will turn crank pins from 3 in. to 11½ in. in diameter.



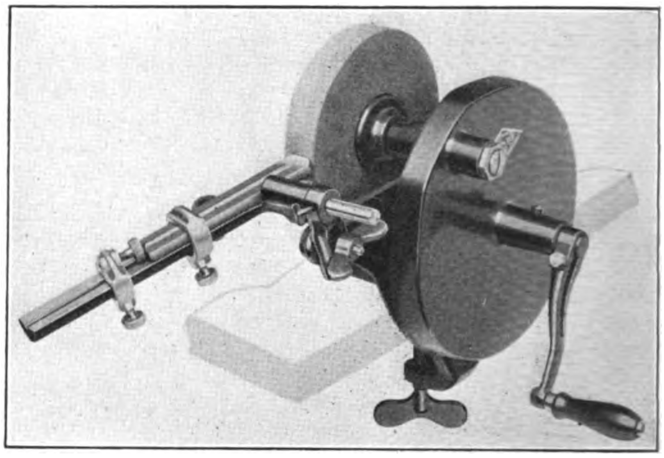
A Crank Pin Machine Using Two Tool Bars with Automatic Feed

This crank pin turning machine has been successfully used at Atlanta, Ga., in the Howell shops of the Seaboard Air Line. On account of its unusually light weight, it can be easily transported and set up.

Luther No. 177 Railroad Grinder

A PORTABLE grinding machine has recently been put on the market by the Luther Grinder Manufacturing Company, Milwaukee, Wis., which was built especially for railroad shop use. The machine was designed for use in grinding either twist, or flat drills, chisels, dies, or similar tools requiring a sharp, perfect edge essential to good machine tool work.

It is possible to grind many different tools on this machine by using the attachments supplied with it. The accompanying illustration shows in use the attachment for grinding a flat drill. The principal object in view when designing these attachments was to make it possible for unskilled workmen to grind drills at correct angles. The attachment is fastened on the machine and a drill clamped to the holder. Two adjustments are made, one for length and the other for the diameter of the drill. The drill is arranged to swivel in the holder to enable the entire surface to be ground smooth and uniform. The attachment shown can be applied to hold the drill in each of three different positions, enabling the operator to grind the proper clearance on the drill and to provide a rake on the cutting edge. An effective wheel dresser is regular equipment with the grinder, which can be applied to the attachment bar, making it possible to dress the wheel uniformly. Luther Dimo-Grit wheels are used on this machine.



A Grinding Machine Designed for the Unskilled Workman

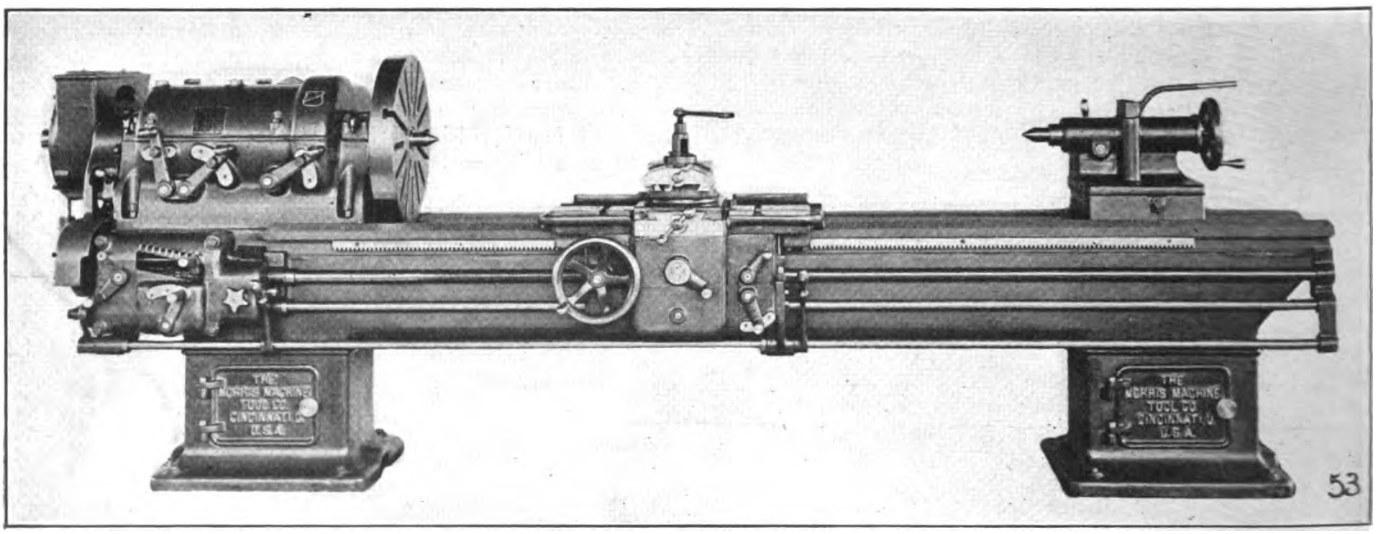
Twenty-Two Inch Geared Head Lathe

AN important addition to the family of engine lathes has been made by the Morris Machine Tool Company, Cincinnati, Ohio, in the 22 in. engine lathe illustrated. The lathe is ruggedly built to withstand the severest kind of usage that the machine will have to undergo in using a ¾-in. by 1½-in. tool. The operating levers on the apron are conveniently arranged so that the mechanic will always be positive in any move he makes.

Twelve selective main spindle speeds are provided by the single pulley driven geared headstock. All speeds are obtained through sliding gears and a positive back gear clutch. All gears except the large face gear and the large back gear are of special alloy steel and heat treated.

The spindle is made of 50-point carbon hammered crucible steel which runs in phosphor bronze bearings. The bearings are lubricated from large reservoirs and the oil holes are fitted with handy oilers. The front bearing is 3¾ in. by 6 in. The hole through the spindle is 2 in. in diameter. The spindle nose has five threads per inch, U. S. S., and a No. 6 Morse taper. The minimum spindle speed is 10 r.p.m. and the maximum 350 r.p.m.

The headstock cover is made in a single piece and can be removed, giving free access to the gears controlling the spindle speed. A definite oil level is maintained to permit the gears to dip enough to insure lubrication. It is recommended that the oil in the head stock be renewed every 60 days. The driving pulley is fully enclosed and provided with a friction clutch and brake operated by a lever on the apron and at the headstock, permitting the operator to start, stop and apply the brake without leaving his working position. The carriage travels on a vee at the front and on a flat track at the rear and is gibbed to the bed both front



Twelve Speed Geared Head Lathe With Single Pulley Belt Drive

and back. The back of carriage is drilled and tapped to receive a taper attachment. The compound rest swivel is graduated in degrees and clamped by a single bolt through a dovetailed clamping ring.

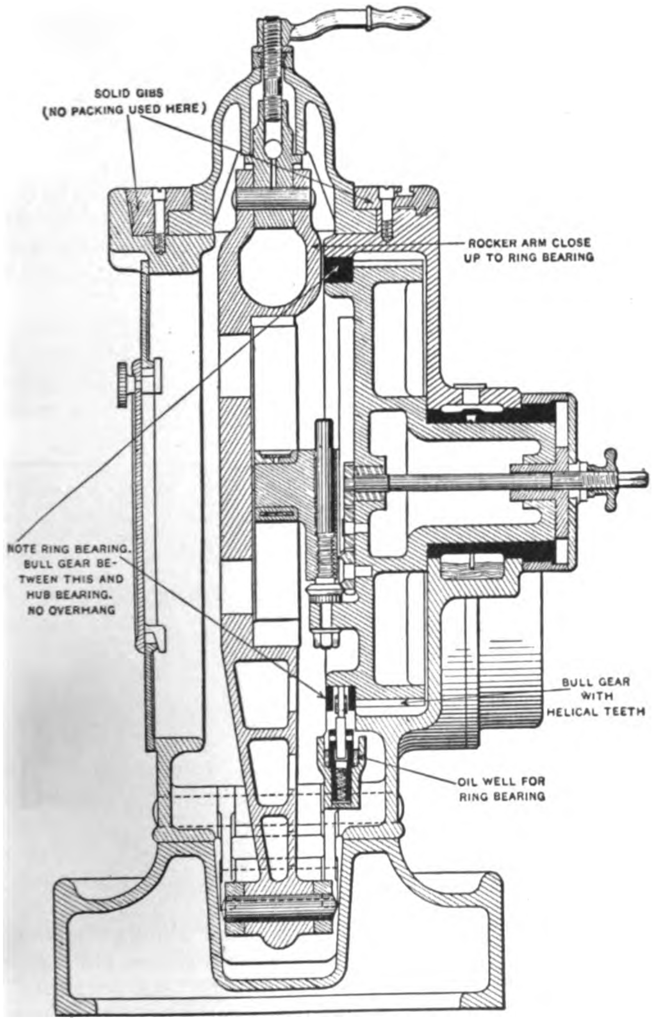
The apron is a one-piece box casting in which all bearings are cast integral. The gears and shafts are supported at each end. All gears are steel and machine cut. Both cross and longitudinal feed clutches are operated by a single lever. An interlock prevents the possibility of engaging thread and feed mechanisms at the same time. This provides adequate protection for the feed gears.

Any standard type motor that has a capacity of five horsepower and does not exceed a speed of 1,200 r.p.m. can be used to drive this machine. The motor is mounted on the headstock and drives through an endless belt with an idler. The idler pulley and bracket are mounted on the motor plate, making the entire unit self-contained. Either chain or geared drive can also be furnished.

A Heavy Duty 32-in. Crank Shaper

A HEAVY duty crank shaper for railway practice has been added to its line of shapers by the Stockbridge Machine Company, Worcester, Mass. The crank wheel has been designed to eliminate overhang and increase its rigidity when operating at long strokes which tends to eliminate the gouging of the tool into the work.

The bull gear in this shaper is carried between two bearings, the usual hub bearing on one side and an outer support or ring bearing on the opposite side. This outer bearing is on the inside of the column, placed close to the rocker arm and consists of a ring fitted into the column. The full diameter outer journal of the bull gear revolving in the ring bearing is lubricated by means of rollers running in an oil well. The additional rigidity obtained by the use of the two bearings, as described above, is of great value, not only under heavy roughing cuts, but also in wide finishing cuts where freedom from chatter is essential. The bull gear and pinion have helical teeth.

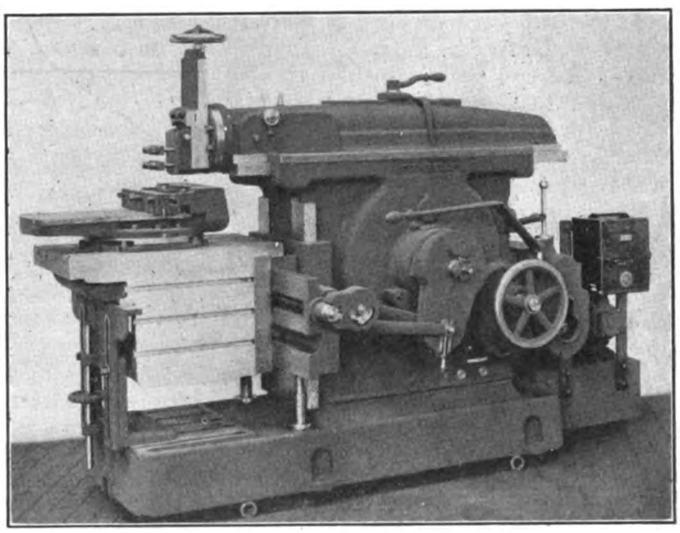


Double Bearing for the Bull Wheel Which Eliminates the Overhang

The ram is a box section, heavily ribbed, and has square guides. The wear is taken up by two full length solid gibs without the use of packing. The taper gib on the rear and the flat gib on the front are both provided with planing strips to take up the wear. The gibs are both bolted directly to the column. The ram can be positioned and adjusted to any length of stroke without stopping the machine. It is provided with eight speeds.

The head has a graduated swivel for setting to any angle and is provided with a clapper box of improved design with a planer type solid binding clamp. The clapper is fitted with straps and bolts instead of the usual tool post. The tool head is provided with a rapid hand traverse.

The crossrail is of the three-track type and is elevated by two screws instead of the usual single screw. The saddle is held in position by two square taper gibs and a third gib at the bottom prevents lifting.



The Motor Drive Arrangement and Operating Handles Are Within Easy Reach

The table has two working sides and can be easily removed for clamping work direct to the saddle. It is bolted to the saddle and hooked over it, thus taking all thrust of the cutting tool against solid metal and relieving the knee bolts. The top of the table has clearance to allow T-bolts to be placed from either end. The table support gives a bearing to the full width of the knee and is provided with an elevating screw.

The cross feed operates only on the return of the ram and cannot be fed on the stroke, thus eliminating all danger of breakage from this source. The feed is automatic and can be varied or reversed while the machine is in motion. Its amount is not affected by changing the direction. The table is fed in either direction by simply throwing a handle

to the right or left. This handle is located in a convenient position for the operator.

The movable jaw of the chuck is made in halves. Each half swivels and is independent of the other, permitting taper or irregular shaped work to be held rigidly. Two adjusting screws are provided for each half jaw. The base is heavy and is extended to provide a support directly under the body jaw. The swivel base is graduated. A single or double screw vise may be substituted if desired.

The speed box is of the selective sliding gear type, with a ball shift, and has four changes. The gears are steel, heat treated and run in grease. The teeth are chamfered to permit easy shifting. Means are provided to prevent idling of the back gear shaft when the machine is running on a belt.

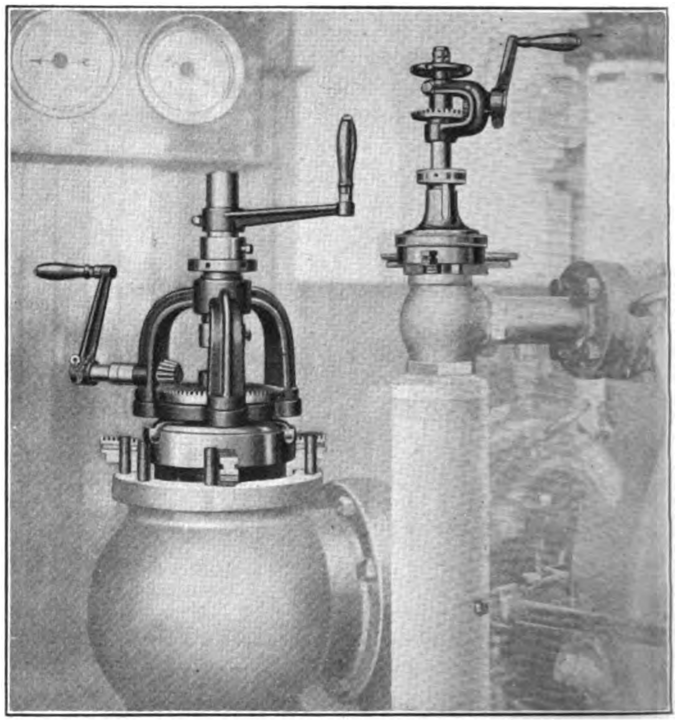
The belt drive is by a constant speed pulley, fully enclosed, direct from the main line. The friction clutch and brake for starting and stopping are controlled by a horizontal lever within easy reach of the operator. The ram can be moved back and forth by this same lever for setting up work. A hand wheel is also provided for fine settings. The motor drive consists of a constant speed motor mounted on an extension of the base of the machine. The motor is connected to the gear box through gearing. Any alternating or direct current motor having a speed of from 1,700 to 1,800 r.p.m. is recommended.

Special attachments for railroad work, including an extended circular feeding head for locomotive driving boxes, a shoe and wedge chuck and jib crane, can be supplied.

The Dexter Valve Reseating Machine

THE Leavitt Machine Company, Orange, Mass., has developed what is known as the Dexter valve reseating machine, which is designed particularly for use around railroad shops and power plants. Any type of valve may be quickly reseated by this machine without removing it from its pipe connections. This reduces the time element to a minimum.

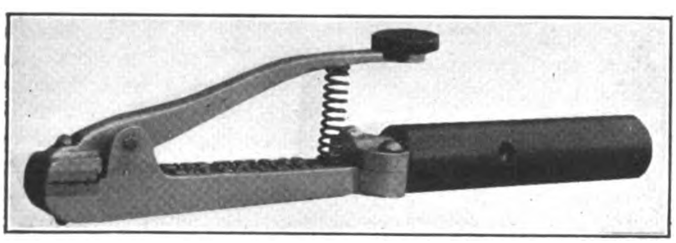
The machine is simple to operate. The tool is attached to the valve by means of the universal chuck principle which is similar to the usual type of lathe chuck. The jaws of the machine are simultaneously adjusted to the valve casing by rotating the scroll of the chuck. This accurately centers the machine with the tool shaft in perfect alinement. A cutter, suited to the type of valve to be reseated, is fastened to the end of the tool shaft, which is then run down to the valve seat and rotated by a bevel pinion and gear. A bearing sleeve supports the tool spindle practically its entire length, which strengthens the tool shaft and keeps it perfectly in line regardless of the strain on it. This adds greatly to the life and usefulness of the machine. The bearing sleeve with the tool shaft slides through the chuck and with the cutter attached is instantly lowered to the valve seat. The cutter is fed into the valve seat until the seat is perfectly true and all defects removed. This saves the cost of the valves and also the cost of taking out leaking valves and putting in new ones, which in many cases is more than the cost of the valves. The steam and water which had been wasted because of leaking valves is now saved.



This Machine Reseats Valves Without Taking Valve from Its Connections

A Welding Electrode Holder Which Does Not Heat

A NEW type of welding electrode holder has been developed by the Gibb Instrument Company, Bay City, Mich., with the object in view of overcoming heating. In the past, electrode holders for spot welding have heated



This Holder Is Made from Aluminun and Weighs 15 Oz.

up to the extent that the welding had to be discontinued to give the holder time to cool. This has been due particularly to connecting the leads to the holder internally and to the poor conductivity of the material used in the tool. This source of trouble has been eliminated by using outside connections to substantial, but light material of high conductivity. The handle of the holder is air cooled by means of a fiber cylinder, which permits free circulation of air through the handle.

The various members are made from aluminum castings and the holder weighs but 15 oz. This light weight does not readily tire the operator. One of the characteristics of aluminum is its high electrical conductivity which results in reducing the heating to a minimum.

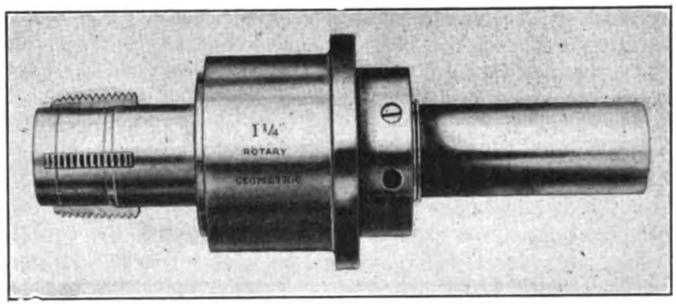
Frequently the wire electrode is used to the last fraction of an inch and an arc is drawn on the holder, or the wire may slip between the jaws. This need occur but a few times before an entirely new holder is necessary. Renewable copper jars are provided for this contingency. The spring under the fiber thumb piece can be quickly interchanged when worn out and is kept cool by exposure to the air. The interchangeability of parts prolongs the life of the holder.

Geometric Adjustable Collapsing Rotary Tap

THE Geometric Tool Company, New Haven, Conn., has to offer a Geometric tap which can be used as a hand or automatic drilling machine. The tool is compact, simple to operate, and requires very little operating space. Its capacity is from one inch up.

The tap is simple in contruction, consisting of five units only. The parts subjected to wear are hardened and ground. The chasers are quickly removed for grinding or renewal by taking off the cap on the front of the tap. They are also provided with a micrometer for adjusting them to produce a tight or loose thread and may be expanded without slowing down or stopping the machine spindle.

The flange trip is operated by coming into contact with the closing forks, or collar attached to the machine and the opening and closing of the tap is controlled by the flange. The trip is set for the exact length of thread required and when it strikes the work, the chasers recede automatically, permitting the withdrawal of the tool.



The Chasers Can Be Expanded Without Changing the Speed of the Machine Spindle

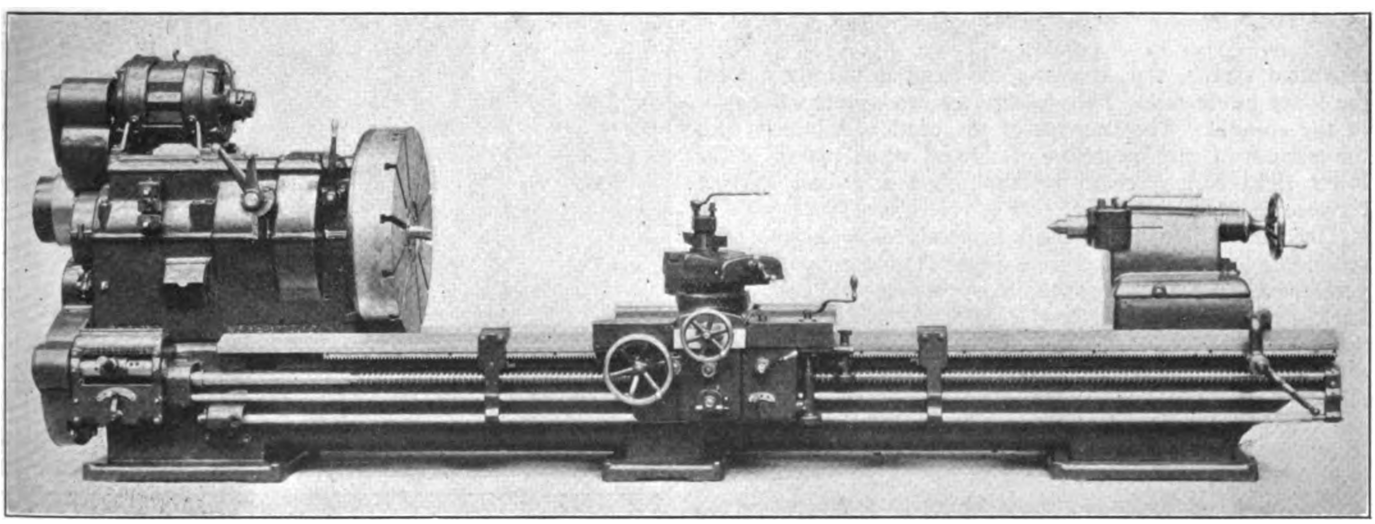
Le Blond Self-Spacing Lead Screw Supports

AN improved type of lead screw support has been developed by the R. K. Le Blond Machine Tool Company, Cincinnati, Ohio, which has been added to its heavy duty lathes as regular equipment. The principal features of the design are its automatic action and massive construction.

The carriage, as it travels along the bed, automatically engages such supports as it may come in contact with, carries them to the end of the carriage travel and upon return releases them in their respective initial positions. They are never pushed along and left at the ends of the bed as is the case with supports of the ordinary type. Consequently it is never necessary for the operator to move them along the bed by hand, which, being a rather laborious procedure, is often neglected, so that the benefit of the lead screw support is entirely lost.

The action of the Le Blond supports is extremely simple. Each support is provided with a spring controlled hook pawl. This pawl engages a hardened locking stud on the carriage, or, as is the case when more than two supports are furnished, a similar stud on the adjacent support. The pawl and stud provide a positive lock that will stay in engagement until released. Each pawl carries a release pin so located as to engage a similar pin fixed in the bed. As the support is carried along, these pins come into engagement, their engagement immediately releases the pawl from the locking stud and the support is left in its proper position. The pawl release pins and the bed pins are of varying lengths, in pairs, so that each pawl pin is engaged only by its corresponding bed pin. By this arrangement the supports are dropped in order in their respective positions.

With this type of support the lead screw is at all times rigidly supported at proper intervals. Consequently the alinement and accuracy of the screw are indefinitely maintained.



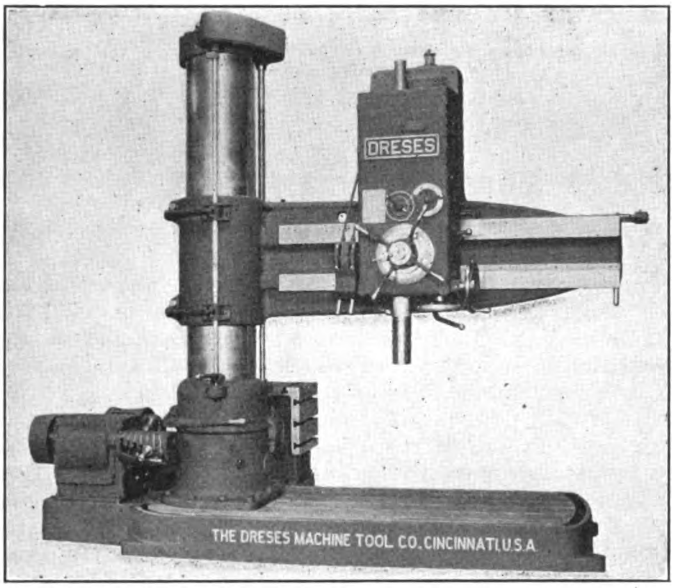
A Le Blond 36 In. Heavy Duty Geared Head Lathe Equipped with Self-Spacing Lead Screw Supports Which Automatically Return to Their Initial Positions

In addition to providing an effective supporting means for the lead screw, these supports also serve the feed rod and the spindle control rod. All three have generous babbitt lined bearings in the supports. The supports themselves are of heavy section and take an unusually wide bearing on the front shear of bed. This feature contributes materially to the ease with which the supports may be moved along the bed without the binding and chattering heretofore characteristic of lead screw supports.

A Six-Foot Ball Bearing Radial Drilling Machine

THE Dreses Machine Tool Company, Cincinnati, Ohio, has recently added to its family of drilling machines a 6-ft. multi-duty ball bearing radial drill press. The designer of the machine has developed a number of safety features, such as the entirely enclosed gearing, fool-proof elevating mechanism, simplified lubrication and a large factor of safety in the details.

The head is entirely enclosed and is mounted on three bearings, two in front and one back of the arm, thus distributing the torsional strain when drilling, over the entire arm. It is clamped by means of a single lever, conveniently placed at the lower left corner, which actuates two widely



Radial Drill With an Interlocked Arm Clamping and Elevating Mechanism

separated screws, thus drawing the head up firmly against the lower guide rail. This feature assures proper alinement of the spindle. The traverse of the head is obtained with the greatest of ease by means of a hand wheel placed at the lower right corner, operating through a full ball bearing traverse mechanism.

The lubrication of the head is obtained by means of a combination of splash and force feed. The forward and reverse gears and frictions run in a separate oil bath. The back gears and spindle drive gears are oiled by means of a power-driven pump, which draws the filtered lubricant from a reservoir and forces it through a visible glass sight on top of the head. The lubricant then cascades over all gears and bearings, and finally returns to the reservoir where it is filtered and recirculated. The spindle and all feeds and traverse mechanisms are oiled by means of a tilting hopper, which distributes a predetermined amount of filtered oil, taken from the circulating pump supply. This hopper is manually operated by a lever conveniently placed on the outside of the head. All the operator has to do is to turn the lever down, hold it there an instant, and then release it. It automatically returns to its former position.

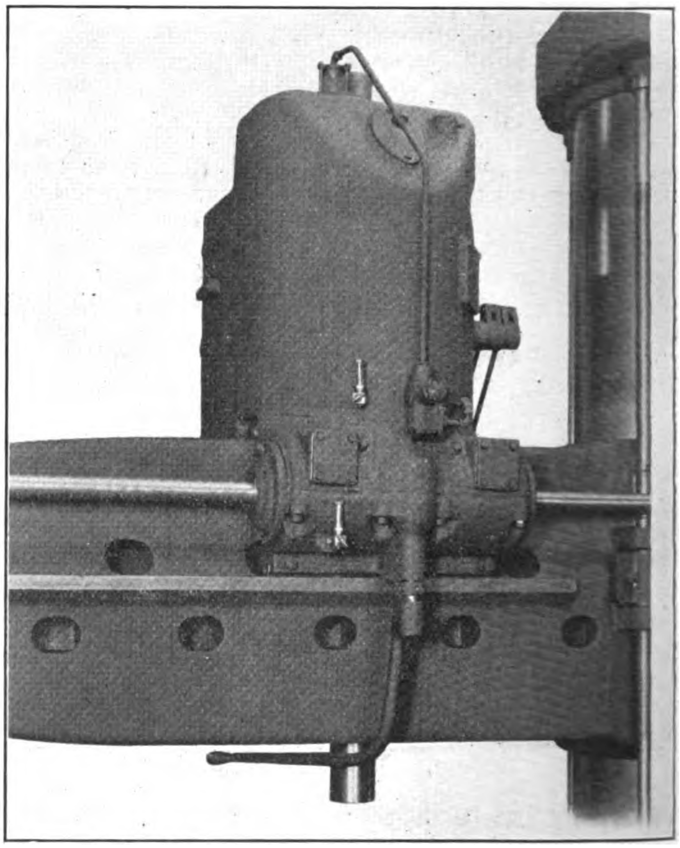
The spindle of large diameter high carbon steel, runs in renewable phosphor bronze bearings. The thrust is taken on two ball bearings. The rack is cut directly on the heat-treated alloy steel spindle sleeve, insuring a wide bearing for the rack pinion, and bringing the point of pressure close to the center. The rack pinion, also of heat-treated alloy steel, has a form of tooth which eliminates the undercut usually found below the pitch line on small diameter pinions.

The tapping, starting and stopping mechanism is of the frictional type, is embodied in the head and is operated by the horizontal lever shown below the arm. The double expanding frictions are of large diameter and are said to engage and disengage under the heaviest loads without noise, chatter or shock. The bevel gears are steel, heat treated and hardened. The entire mechanism runs in oil.

There are four changes of speed in the head, obtained by two levers conveniently placed at the lower left corner. This, combined with eight changes in the speed box, gives thirty-two spindle speeds. The driving gear, with two long tool steel keys for driving the spindle, rests on an annular ball bearing placed well inside the gear, thereby eliminating objectionable overhang.

Fifteen feeds for the spindle are available, five of which are tap leads for 8, 11½, 14, 18 and 27 threads to the inch. They are prominently indexed, showing feed per revolution of the spindle. The arrangement includes a safety friction interposed in the drive in addition to the large friction quick return.

The friction clutch is of the quick-return type, which can be easily adjusted from the outside with a screw driver. It



Rear View of the Head

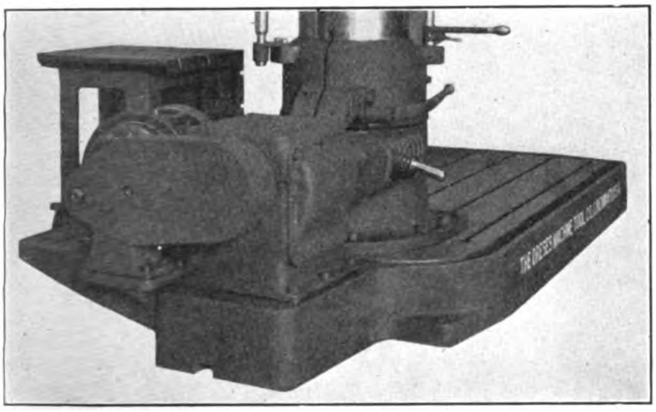
is operated by four levers, any one of which operates the clutch. The dial of the automatic trip and depth gage is graduated in even divisions, avoiding complicated reading should the depth desired exceed one complete revolution of the rack pinion. The trip may be instantly set to disengage the feed at any position in the entire range of traverse. All depths are set to read from zero, and the trip may be passed at any set position by a pull knob. A safety trip is provided at each end of the spindle travel.

There are eleven annular and three thrust ball bearings used in the head construction. The annular bearings are

standard sizes and are mounted according to the best standard practice.

The top cap on the column is entirely enclosed and all gears are made of high carbon steel mounted between substantial ball bearings to insure rigidity. The entire mechanism is lubricated by three large glass oilers.

The miter gears back of the arm and inside the column are drop forgings, heat treated and hardened, and are mounted on ball bearings. The long hub of the gear which drives the vertical shaft in the column, is fitted with a longitudinally yielding contact, which eliminates improper meshing of the



The Constant Speed Motor Drive

gears, prevents the weight of the heavy shaft riding on the gear teeth, and compensates for wear between the column and stump.

The completely enclosed speed box is of the cone and tumbler type, operated by a single lever. It is clearly indexed and the speeds are arranged in successive progression, eliminating the necessity of the operator observing the index whenever he wishes to increase or diminish the speed. The shafts are heat treated alloy steel, and are ball bearing mounted. The gears are wide faced, hardened forgings, and the tee.h are of the 20-deg. involute chamfered form, assuring strength and easy engagement. To overcome shock when changing speeds, during the shift the machine is always run at the slowest speed by means of a self-releasing overtake clutch. The entire mechanism runs in an oil bath.

The arm is of the box parabolic section. The lower rib is double ribbed, giving the greatest resistance to bending and torsional strain. It is equipped with a fool-proof elevating and lowering mechanism and has an automatic trip at both extremes. One lever, within reach of the operator from his position in front of the machine, unclamps, elevates or lowers and then securely clamps the arm by a single movement. In addition to this safety device, the gearing automatically disengages should any obstruction be met in elevating or lowering. The lowering speed is twice the elevating speed.

The column is composed of two parts. The inner member is bolted to the base and reaches to the top of the outer sleeve. Both members are liberally ribbed in the planes of the greatest stress and the annular and thrust loads are taken on roller and ball bearings.

The base is rigidly constructed on the full box section principle, is deep in section and well ribbed both longitudinally and transversely. A liberal oil channel encircles the entire base, thereby allowing the lubricant to return to the reservoir from both sides.

The operation is convenient and simple. The operating levers on the head are within a radius of 17 in., yet are not crowded, each lever having ample hand room and operating clearance. The levers at the base of the column, including the speed box, the column clamp and the new combination arm clamp and elevating handle, are also all within a 17-in. radius.

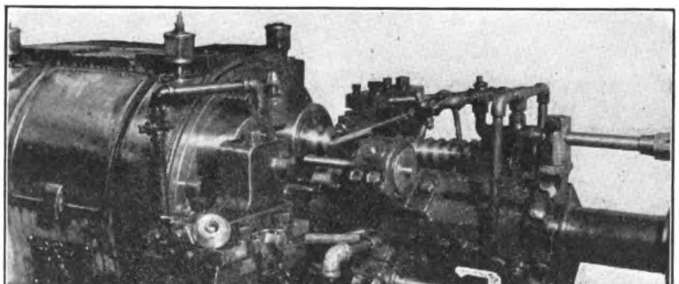
The rigidity of construction, the extraordinarily wide face, coarse pitch steel gearing, the heavy, well-supported shaft mounting and over-size ball bearings for the entire drive combine to make this a powerful machine. It may be driven by a belt through a speed box, by a constant speed motor and speed box, or by a variable speed motor drive. A plain box table is regularly furnished with the machine but a universal table can be furnished if desired.

An Acme Four-Spindle Screw Machine

The National Acme Company, Cleveland, Ohio, has added to its list of machine tools a 2-in. size automatic screw machine. This tool in principle is similar to the 3-in. and 4-in. machines, which were described in the May, 1922, issue of the *Railway Mechanical Engineer*. The machine is equipped with adjustable taper bearings, extra wide forming and cut-off slides, double decked toolholders, a new style finger holder and a hand chucking device, which are not found on the 3-in. and 4-in. sizes.

The friction in this machine is reduced to a minimum by means of taper bearings, which provide adequate adjustment for wear. Work may be accurately machined because of this mechanical improvement. The spiral and helical gears are all hardened and ground and tend to give a more positive drive and decrease the noise. The machine is provided with extra wide forming and cut-off slides. The object of this improvement is to provide for the use of the double-deck toolholders and to permit the taking of heavier cuts. These slides run between hardened and ground tapered gibs, and are operated directly from a cam instead of through a compound lever, as is the case with the larger machines. Double-decked toolholders are mounted on the forming slide. This toolholder permits forming operations in both the first and second positions without the use of a top slide.

These finger holders on the 2-in. machine, are adjusted to give the proper tension on the work and, at the same time, are so arranged that they cannot fly open when feeding the



An Acme Screw Machine Provided with a Double-decked Toolholder

stock or when operating at a high spindle speed. The machine is also equipped with a hand chucking device.

Blacksmith Forge Equipped with Pressed Steel Hearth

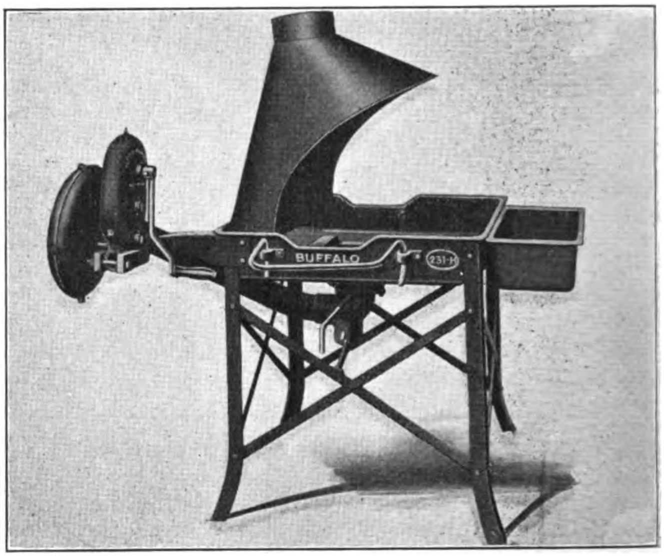
A NEW feature, consisting of a pressed steel hearth in place of the three-piece construction formerly used, has been introduced by the Buffalo Forge Company, Buffalo, N. Y., in its line of blacksmith forges, one of which is shown in the illustration. This has resulted in a stronger hearth, which is more durable and has a better appearance. The other features that have been common to these forges, such as the angle iron legs, hand blower, rolled steel hood and cast iron fire pot have been retained in the new design.

The hearth, as it is now built in these forges, is 30 in. square. The water box is 24 in. by 10 in. and is also of pressed steel construction. The old hearth was made in three separate pieces consisting of the bottom, the sides and a reinforcing ring or plate for the fire pot. In this type of construction the sheet steel side and bottom plates were seamed or welded together, the bottom piece being made of heavy sheet metal and the sides of lighter material. The new hearth has been designed to eliminate the difficulty caused by the loosening of the bottom and side plates in the older type of construction. This loosening was usually followed by the formation of rust in the seams and consequent corrosion. The new hearth and water pan are built with rounded corners and there are no joints to cause trouble.

A further advantage of the pressed steel construction is the use of one gage metal throughout. The sides and bottom are made of 12 gage sheet steel, which provides for greater rigidity and strength in the hearth. A crimped edge has been substituted for the reinforcing ring of the fire pot, which provides sufficient reinforcement in itself. Another important feature of this construction is the fact that greater simplicity has been obtained. The hood furnished with these forges is made of rolled steel in two halves, which are spot welded together. The legs are made of angle iron and are flared at the bottom. The fire pot is cast iron.

This company has also adopted a one-piece construction of similar design for its line of rivet forges, hand and power blowers. This is intended to take the place of the cast iron construction formerly employed and the built-up steel hearth. As in the case of the line of forges illustrated, the other characteristic features will remain unchanged. With the exception of one line, known as the 700, all of these forges are equipped with New Departure bearings in the blower heads. The 700 line is furnished with plain reamed bearings.

The gear ratio on all the forges is 47½ to 1. A plain

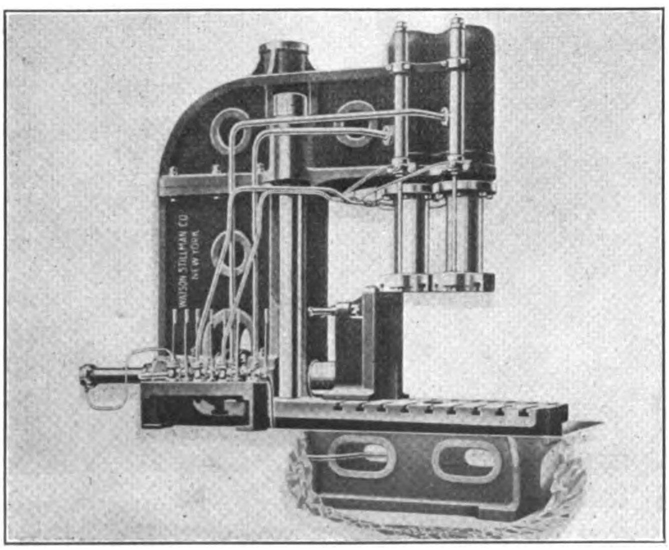


A New Hearth of One Piece Construction Has Given Additional Strength to These Forges

sliding ash pit cover is furnished on all the forges, with the exception of the No. 222 forge, which is equipped with a balanced ash pit cover. The blower crank may be turned backward or forward with equal blast on any of the various types, and the fan cases are so designed that all excessive churning is avoided.

Hydraulic Flanging Press of the Built-up Type

A LINE of hydraulic flanging presses of the built-up type, in four sizes, has recently been brought out by the Watson-Stillman Company, New York. The



Press with Two Upper Vertical Rams, a Lower Vertical Ram and a Horizontal Ram

main frame of the press is built in sections, securely bolted together, a construction in which many of the faults found in making the main frame in a single casting are overcome by such a design.

The frame is exposed to comprehensive strains only, which has permitted the use of a lighter section. All tension strains are taken up by the two heavy columns or bolts which secure the two parts of the main frame together and the deflection is thus reduced to a minimum. With this construction, in case repairs to any part are necessary, or replacement of the main cylinders is required, it is necessary to renew the one part only.

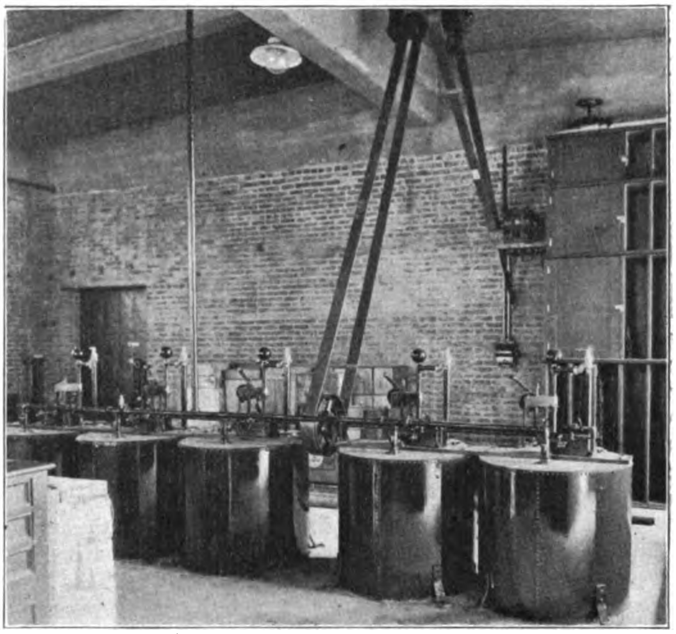
The return stroke of the main rams is effected by a draw-back cylinder below the top of the frame. This reduces the overall height of the press, making it possible to install the machine in restricted quarters. It also facilitates the mounting of a swing crane on the top of the press for the handling of materials.

The presses are usually fitted with two upper vertical rams, one lower vertical ram and one horizontal ram. The main cylinders are connected through special filling valves to the main pressure line, thereby increasing the speed of the ram and at the same time reducing the consumption of high pressure water. They are made in four sizes with total pressures on the vertical cylinders of 150, 200 and 300 tons capacity.

Promoting Economy in Paint Distribution

PAINT has always been a source of more or less trouble for the railroads to handle at points where it is kept in storage and used periodically. The usual practice has been to receive and hold this material in barrels, a practice which has resulted in much wastage from broken or sprung barrels and also in trouble owing to the tendency of the pigments to settle. Where agitation has been attempted this has been accomplished by loss of paint owing to chemical and physical changes resulting from contact with air, while at the same time loss has also resulted from the primitive methods of measuring out the oil in small lots.

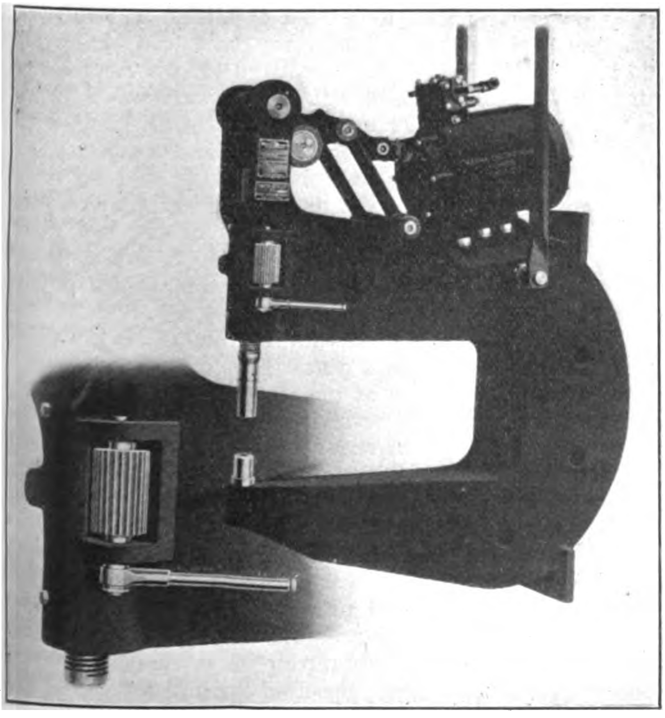
These problems have been solved on a large railroad by the installation of a series of five combined mixing tanks and measuring pumps, as shown in the illustration. Each of these tanks consists of a steel cylinder of sufficient capacity to hold all of the paint of one kind desired and keep it from contact with the air at all times. Each cylinder is equipped with an agitating device and all of the cylinders are arranged in a row so that all agitators can be operated from one shaft, which, in turn, is operated by an electric motor. In addition, each cylinder is equipped with a self-measuring pump similar to pumps in use for distributing oil except that the pumps, of necessity, are specially designed for handling paint. All of the tanks are filled from a pipe line which avoids any wastage of oil in this operation. The tanks are so arranged as to require one, when securing paint, only to turn on the electric motor momentarily and then to measure out the required quantity of paint by means of the hand-operated, self-measuring pump, situated on the ground level at one side of the tank. This equipment is the product of the S. F. Bowser & Co., Ft. Wayne, Ind.



A Battery of Paint, Oil and Mixed Paint Equipment Ready for Use

A Die Screw Adjustment for the Hanna Riveting Machine

AN accessory for use in connection with its pneumatic riveter, has recently been developed by the Hanna Engineering Works, Chicago, Ill., the use of which makes possible exceptionally rapid die screw adjustment. The mechanism allows the riveting machine to be employed on work of varied plate thicknesses, with very little loss of time in adjusting the dies at each new grip. With ordinary variations in thicknesses of plates on the Hanna pneumatic riveter it is not necessary to readjust the die screw. This is provided for in the riveter by a patented mechanism that develops a predetermined pressure uniformly throughout the last half of the piston stroke, or the last ½ in. (1 in. in machines of 100 tons and over) of rivet die travel. The motion is a combination of toggles merging into a lever action. It automatically applies sufficient pressure and follows up the shrink of the rivet under full tonnage until it is cool enough to have taken its set.



A Die Screw Adjustment Device Which Reduces Labor and Time to a Minimum

In large variations in thicknesses of plate the new die screw adjusting device reduces the labor and time to a minimum. A few pulls on the ratchet handle advances the die screw the desired amount in an exceedingly short time, thereby avoiding the interruption of the continuous operation of the riveter. If no adjusting device is provided and the die screw adjustment is necessary, it must be made with a pair of tongs, as the screw itself naturally becomes too hot to turn by hand.

The actual details and working mechanism of this die screw adjusting feature are clearly shown in the illustration. The rotation of the ratchet handle causes the large ratchet gear to rotate. Motion is transferred through an idler gear to the vertical gear, which is attached rigidly to a vertical gear shaft. This shaft is securely fastened by a pin to the upper end of the die screw, which it rotates. The vertical gear, the idler, the plunger, and the die screw form a single unit, which reciprocates with the mechanism. The ratchet gear is of such length that the idler can slide on it for the full stroke and remain enmeshed at all times. This mechanism is an addition to the standard riveting machine built by this company.

The Bradley Sanitary Washfountain

A FOUNTAIN lavatory made of a concrete composition material which is impervious to water and grease, and is suitable for use in railroad shops is manufactured by the Bradley Washfountain Company, Milwaukee, Wis. The concrete composition is treated by a series of special processes which hardens it and decreases its tendency to deteriorate with usage.

These fountains are so constructed that sanitary conditions about the room in which they are used are greatly improved. The fountains have no joints, corners, depressions, nuts, washers or bolts where dirt may collect. They are circular in shape and their height from the floor is such that the elbows of the users extend over the wall of the fountain. This feature of construction catches the water drip and prevents the floor from accumulating dirt and waste matter. The fountains are kept clean by the sprays which have sufficient force to wash away soap suds and dirt. The waste pipe and connecting fitting are two inches in diameter, which is large enough to carry off any accumulation of dirt, and greatly reduces trouble from this source. Any type of trap may be used. Each fountain has its own mixing device for hot and cold water but a wall, or thermostatic mixer, may be used if preferred.

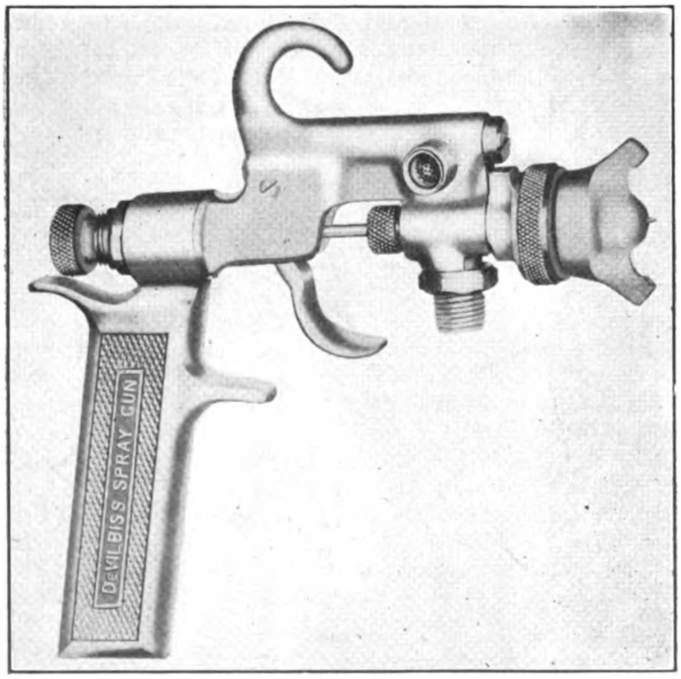
The water supply pipe is ½ in. in diameter and the fountain consumes a minimum amount of water. Attached to the end of the pipe is a ⅜-in. discharge valve. This size pipe and valve require not more than 6 lb. water pressure to supply an ideal spray for washing. If the water pressure exceeds 6 lb., the discharge valve will not open any more than necessary to provide a suitable spray. Such a spray furnishing water for ten persons uses approximately three gallons of tepid water per minute. A mixture of cold water at 50 deg. F. and hot water at 180 deg. F. produces a temperature

These Fountains Permit a Miximum Number of Users to Occupy a Minimum Amount of Floor Space

of 115 deg. F., which is considered a comfortable temperature for use.

A Spray Gun with Few Wearing Parts

A NEW spray gun has been developed by the DeVilbiss Manufacturing Company, Toledo, Ohio, which embraces mechanical improvements of design and



This Spray Gun Gives Instantaneous Control of the Fluid

construction that insure simplicity of operation, cleaning and maintenance. It embodies the best points of all the spray guns developed by the DeVilbiss Manufacturing Company during the last 14 years.

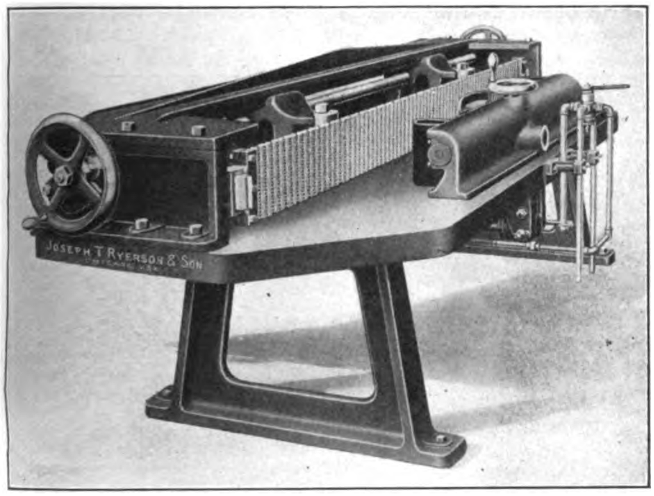
This type of gun has many leading feature advantages. All nozzle parts are self-centering, with fluid tip and air cap being held in positive concentricity at all times, making it impossible for nozzle to get out of alinement even when parts are interchanged. The spray head can be quickly detached and a different head replaced to suit the grade of paint being used. One model, with a variety of nozzle sizes, enables the operator to use material of all kinds on all classes of work. The number of parts and wearing points is small. There is only one pivot bearing and no yokes, links, pins or push rods. All the moving parts are enclosed and protected, thus prolonging the life of the tool. The fluid tip is made of nickel alloy steel, which is heat treated and ground. All parts are interchangeable, which permits quick repairs.

The spray gun is equipped with a revolving air cap which produces a horizontal or a vertical wide, fan spray, or a round concentrated spray as the work for which it is being used may require. The revolving air cap produces a perfectly atomized, uniform spray under all conditions, with the lowest possible combination of air and fluid pressure without splitting or a heavy center. The spray gun has a quick fluid needle adjustment, giving the operator instantaneous control of the fluid. There is no dripping of material from the nozzle due to the positive fluid cut-off at the nozzle orifice. The fluid is guided through the spray gun by a short, unobstructed passage, which results in the material coming into contact with only three parts of the gun: namely, the bore of the spray head, the fluid tip and the needle. It is said that the gun can be taken apart in less than 15 sec., cleaned in 1 min., and reassembled in 20 sec., which is an

important item considering the many times that the fluid passage and the gun may be stopped up by foreign substance in the fluid. The grip of the tool is modeled after the grip of an automatic pistol which gives perfect balance. This, combined with extremely light weight and free trigger action, provides for easy, non-tiring operation.

An Elliptic Spring Forming Machine

An elliptic spring forming machine has been placed on the market by Joseph T. Ryerson & Son, Inc., Chicago, which in general consists of a heavy table, upon which is mounted a flexible steel band of chain links held at the ends by a double set of springs. Back of the flexible band are two supporting blocks, moved out or in by right and left-hand screw and hand wheel to regulate the effective length of the band.



A Spring Forming Machine Adaptable to Railway Practice

In operating, the hot leaf to be formed and the cold leaf which fits next to it in the completed spring, are placed on the table together, centered by their nibs. The hot leaf is placed against the chain and the cold leaf next to the crosshead. Pneumatic or hydraulic pressure forces the crosshead and springs against the chain. The hot leaf forms accurately against its mate as a result of the resistance of the flexible chain to the crosshead pressure against the spring leaves. To give the hot leaf camber, adjustable dies on the crosshead are set to deflect the cold leaf the proper amount, thus reducing the curvature of the hot leaf sufficiently to produce the desired camber.

The leaves formed by this machine are free from twisting or warping and any twists that may have been in the original bar are removed. The operation of the machine is pneumatically controlled which provides a means of forming the elliptic springs which provides a rapid and accurate method of production.

A Boring and Facing Machine for Locomotive Driving Boxes

A BORING and facing machine developed especially for locomotive driving box work has been designed and put on the market by William Sellers & Co., Inc., Philadelphia, Pa. The machine has a special boring bar and a self-centering chuck for holding the boxes. It is a comparatively simple tool of heavy construction, is conveniently arranged and easy to operate.

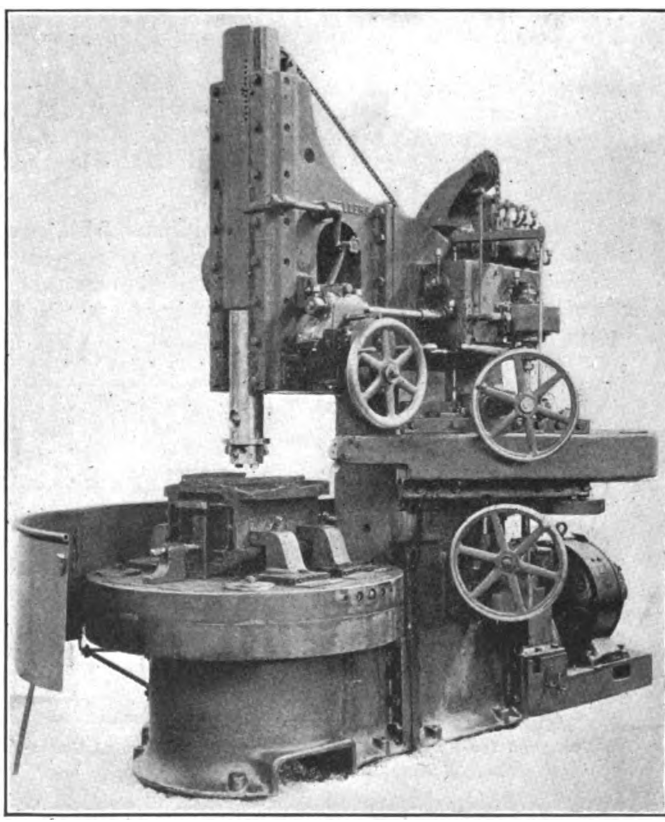
The driving box is mounted in the chuck on the rotating table and bored and faced at the same time. This set-up reduces the cutting time to a minimum. The box may be shifted to a new center while still clamped in the chuck, and the edges of the crown brass relieved to give clearance.

The boring bar is carried by a long steel slide of rectangular section. The boxes are faced by means of a heavy steel horizontal arm also of rectangular section, carried in a massive slide with a vertical adjustment on the upright.

The guides for both the boring and facing slides are extremely long to insure accuracy and durability and shoes are provided for taking up wear. The boring and facing rams are provided with both vertical and horizontal power feeds.

The revolving table is supported on an annular bearing, well lubricated, and has a large center spindle with a taper bushing which is provided with adjustment for wear. The spindle has a collar at the lower end to prevent lifting under heavy facing cuts. The chuck which is permanently attached to the table, is designed so that boxes may be bored and faced, the edges relieved and an oil space cut out in the top of the crown bearing, all at one setting of the jaws, without loosening any bolts or clamps. Two sets of clamping jaws center the box laterally and all four jaws are operated by a single crank. A stop is provided for the top of the box, which is thus held firmly by five jaws.

There are two sets of cutters, a double-end cutter for roughing and a single-end cutter for finishing. Both sets of cutters have micrometer adjustments and means for securely clamping in position.


Sellers Boring Mill With a Self Centering Driving Box Chuck

A variable speed direct-current motor is recommended for driving the machine. This facilitates changing speeds and provides for quick stopping by dynamic braking. If direct current is not available, the machine may be provided with a speed change box and driven by a constant speed alternating current motor, or by a single driving pulley.

Portable Arc Welder Adapted to Short or Long Leads

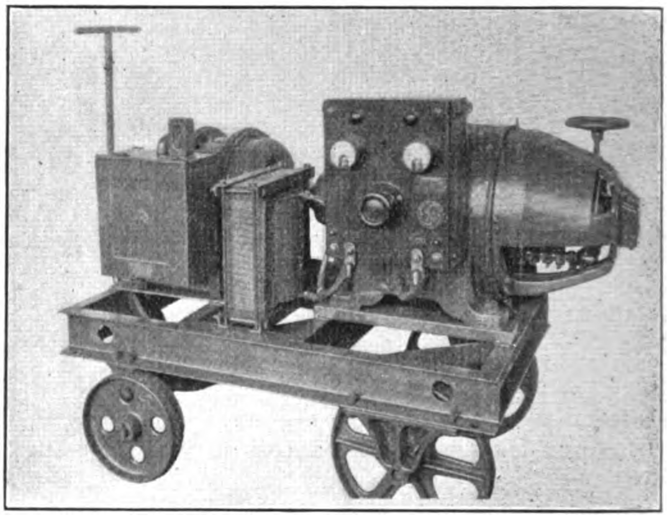
A PORTABLE arc welder, capable of delivering continuous power and permitting rapid production, with either high current and large electrodes, or low current and small electrodes, has been put on the market by the General Electric Company, Schenectady, N. Y.

This welder is a two-unit set, consisting of a motor and a generator. The generator is self-excited, thereby eliminating the necessity for a separate exciter. All regulation of current is accomplished by turning a hand wheel on the generator. A self-adjusting, stabilizing reactor is provided, which automatically steadies the arc under all welding conditions.

The machine can be used with any of the commercial sizes of metallic electrodes, from 1/16 in. to 1/4 in. in diameter. Generator voltage can be adjusted to suit the character of the work. High voltage for complete penetration on heavy work and low voltage to prevent burning through on light work are thus secured at will. Any value of current between 75 and 300 amperes can be obtained in a large number of steps between these limits.

Among the operating advantages of this outfit are: An arc easy to start and maintain, roller bearing wheels, holes in base for crane hooks and adaptability to long or short leads, for working close by or at a distance from the set. Among the mechanical features are included motor and generator insulation designed to withstand severe operating conditions under which ordinary insulation fails. The bearings are waste-packed and oil cannot be spilled if the set is tipped when being moved.

The generator is a two-pole, self-excited, constant-energy, single-operator machine, with a dual magnetic circuit designed to operate at 60 volts open circuit, and 20 to 25 volts under load. It is rated at 200 amperes for continuous service; 250 amperes for one hour, and 300 amperes for short periods. The motor is a standard General Electric 10-hp. unit. The complete set has three bearings, the two units being close-coupled by a solid flange coupling. All parts,

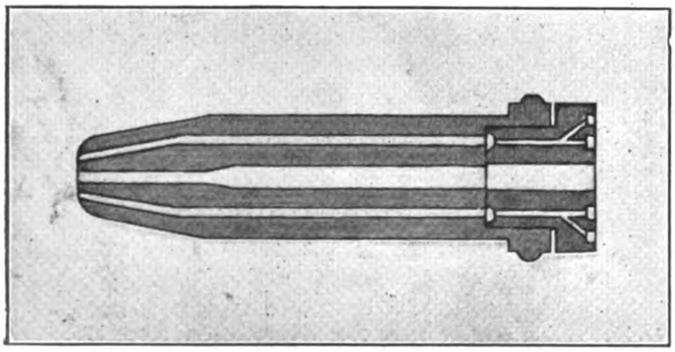


A General Electric Two-Unit Set Portable Arc Welder

including generator, motor, generator control panel, motor starter and stabilizing reactor, are mounted on a welded structural steel base of rigid construction and light weight. The assembled unit is about 63 in. long, 29 in. wide and 47 in. high, weighing about 1,600 lb.

Development in Metal Cutting Torches

THE Alexander Milburn Company, Baltimore, Md., has perfected what is termed a super tip for oxy-acetylene cutting apparatus, which embodies all the desirable features of the standard tip and has a number of additional advantages that are distinct improvements.



A Tip Designed for Fast Cutting and Economical Use of Gases

This tip is designed so as to permit super-mixing of the gases and preheating of the cutting oxygen, as well as to give added velocity and penetration to the preheating and cutting jets. It is provided with a renewable seat at a fraction of the cost of a complete tip, thus rendering it unnecessary to re-machine or discard the used tips. This renewable seat also facilitates cleaning and maintenance. In the standard tip the seat could be refaced by taking off a thin cut on a high speed lathe, but if the lathe was not available, the seat could not readily be refaced which would hinder production in an emergency.

The mixture of the preheating gases takes place in multiple passages in the renewable seat. These gases then pass into an annular passage where they are given a swirling motion and an additional mixing. The gases are again separated and expanded into enlarged multiple passages leading to the orifices in the tip proper. Here the preheating flames are projected with an increased velocity inclined toward the high pressure oxygen jet, which results in a speedier cut, a narrower kerf and a material saving in gases which are desirable features in railway practice.

Comparative cutting tests with the old standard tip show that the super tip is able to bring about a saving of approximately 18 per cent in the cost of operation. The super tip with the renewable seat is interchangeable with all sizes of Milburn cutting tips and will fit all of that company's torches manufactured since 1916.

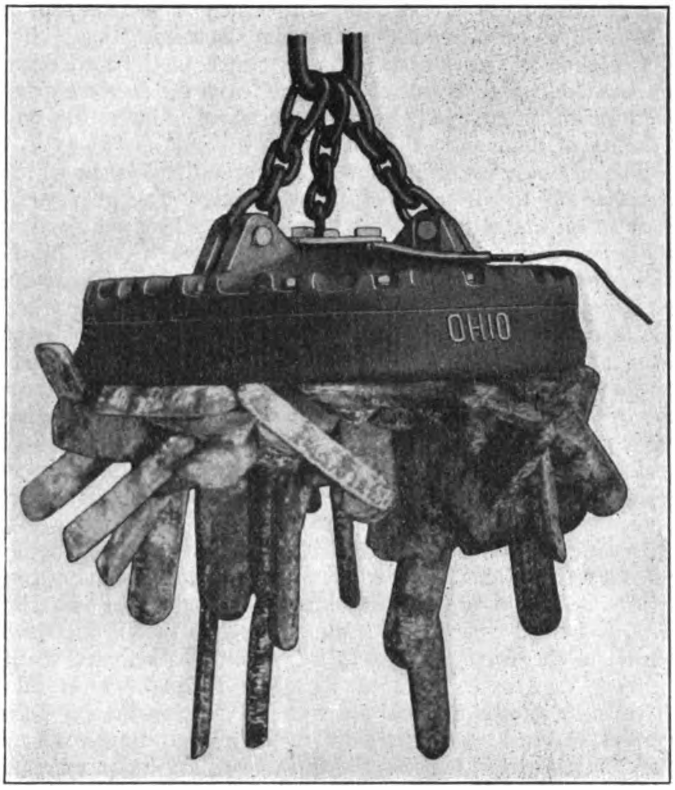
A 65-in. Diameter Lifting Magnet

A LIFTING magnet adaptable for heavy work around a foundry, store house, scrap yard or a metal yard has been added to its line of electrical products by The Ohio Electric & Controller Company, Cleveland, Ohio. It is identical in construction with 45-in. and 55-in. magnets manufactured by the same company, except that the center pole is held in place by three 2-in. studs which replace the center pole supported by a single large bolt cast into the magnet.

Difficulty has been experienced with the smaller magnets from accumulations of carbon dust on the terminal insulator which caused flash overs to ground and left a carbon path which eventually led to a permanent grounding and ruined the insulator. This has been overcome on the 65-in. magnet by placing a heavy insulator around the outside connection and terminal. The coil is brought into contact with the top and bottom of the case on surfaces large enough to conduct the heat to the outside of the case and radiate it to the atmosphere. It is said that the magnet on the outside seldom reaches a temperature of more than 40 deg. C. The coil itself, measured by the increase in resistance method, seldom goes above 80 deg. C. The result of this protection is a high average current which gives this magnet high all day average lifting capacity which provides efficient and economical operation at any time.

The center pole is held in place by three 2-in. diameter studs which are made of 3½ per cent nickel steel. The cap bolts which hold the bottom ring in place are also made of 3½ per cent nickel steel. This feature tends to reduce the wear to a minimum.

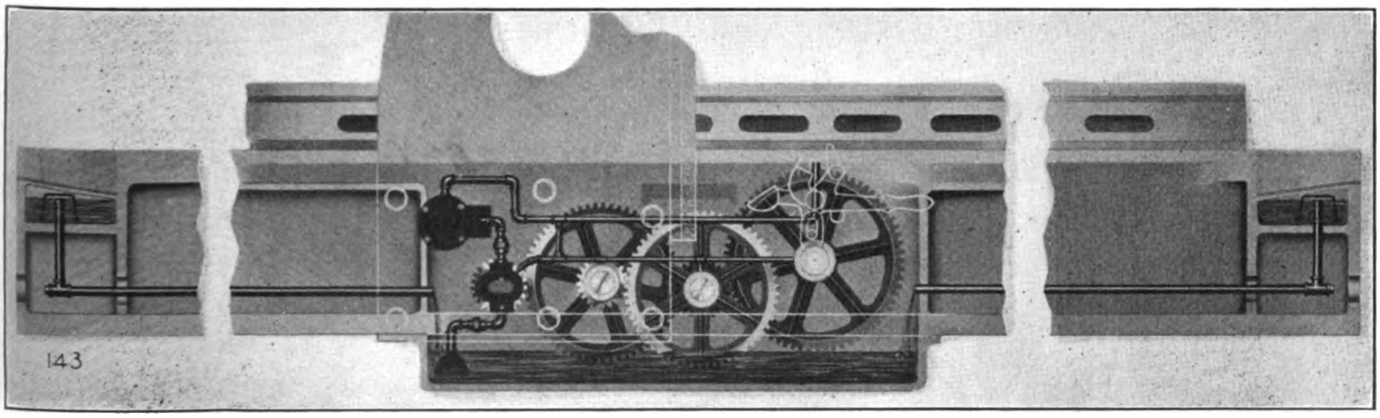
The illustration shows the magnet lifting 5,200 lb. of pig iron. This load was greater than the average capacity because the magnet was cold. The average lifting load for all day service is about 4,000 lb. This requires an average consumption of 67 amperes.



The Center Pole Is Held in Place by Three 2-in Studs

The Gray Planer Equipped with a Self-Lubricating System

A PLANER designed primarily to meet the requirements of railroad shops has been added to its family of planers by the G. A. Gray Company, Cincinnati, Ohio. To this end the machine is built with great weight and rigidity to withstand the heavy cutting and rough use to around the planer. The clamping effect on both housings is automatically balanced and the rail is clamped to the inside edges of the housings, to bring the points of support as close together as possible and shorten the length of rail subject to bending stress when cutting. It can be raised or lowered by



A Lubricating System Which Feeds Oil to All Parts of the Machine

which it must be subjected. At the same time, in order to get rapid production, certain features have been incorporated in the machine which will permit the operator to change the setting of his rail and his heads quickly and without effort.

The rail can be clamped or unclamped to the housings from the operator's usual position and without walking a single motion of the rail-setter lever, which hangs within convenient reach of the operator.

The single-shift rapid traverse will move the heads rapidly into place by the use of the traverse levers provided at the end of the rail within easy reach of the operator. The traverse is designed so that it is not necessary to disengage the feed

mechanism, nor will the hand crank revolve when the rapid traverse is in operation. The feed is of the dial type, but is not driven through a friction. It has a positive drive and can be instantly set to any amount up to 1 in.

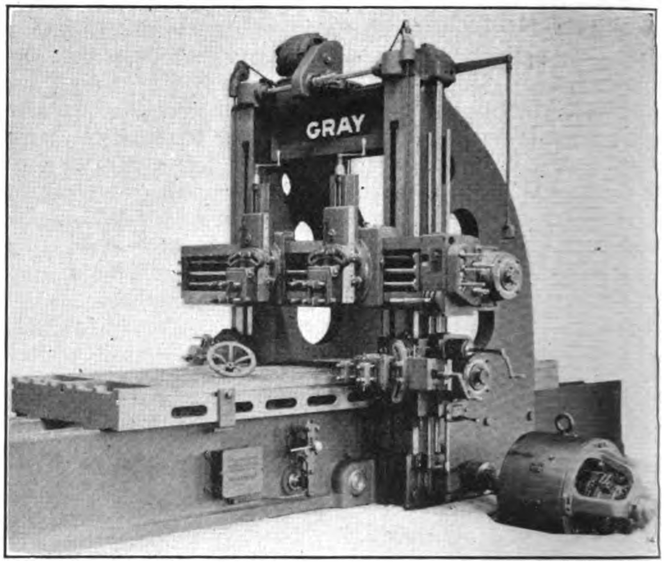
The machine is designed with safety clutches. If the operator attempts to raise the rail when it is clamped, a clutch slips, relieving the mechanism of undue stress. Or, if one head is fed into the other, a clutch in the feed drive mechanism, which is entirely separate from the traverse drive mechanism, immediately relieves the stress, eliminating any liability of damage to the machine.

The machine is equipped with a lubricating system which supplies oil to all parts of the machine. The gear train runs in oil and filtered oil is pumped to each of the driving shaft bearings and to the vees. This insures proper lubrication over the entire surface of each vee irrespective of the length of the table and protects the vees against cutting when the machine is used for planing very short stroke work near one end of the table. The traverse, the feed, and other parts on the end of the rail are entirely enclosed in order to protect the operator and they also run in oil. The small oil cups have been eliminated by substituting one centralized oiler, which delivers clean oil where it is needed. Centralized oilers are also provided on the side heads and on the top brace.

In order to afford a smooth drive which will continue to be smooth and which, if desired, can be used at the high cutting speeds desirable for planing bronze, the machine is built with a helical gear drive train throughout from the first pinion to the drive rack inclusive. Since helical gears are stronger than spur gears of the same width of face, this drive train affords unusual strength. The teeth are involute over their entire surface, thus insuring a rolling contact. The end thrusts of the intermediate gears are balanced, but that of the bull pinion and gear offset the side thrust of the tool. This side thrust of the cutting tool would otherwise tend to push the table up the vees, causing the tool to jam into the work. With its elimination it is possible to take much heavier roughing cuts.

The bed of the planer is made double-length, so that the table does not overhang at the ends. This greatly relieves the usual excessive wear at the end of the bed, and is a protection against accidents.

The machine is equipped with a traverse motor which, although entirely disconnected from the line when not in use, starts instantly when a traverse lever is moved. The motor runs on ball bearings in grease. The control is entirely enclosed and is all metal, without relays, interlocks, resistors, or any delicate parts that might require attention.



The Gray Planner Designed So That the Operator May Change Quickly the Setting of the Rail, and the Heads

A Bolt Turning Machine and Its Auxiliary Centering Device

THE machine illustrated in Fig. 3 is a development for bolt turning which has been brought out by The Walter H. Foster Company, New-York. This machine contemplates turning the bolts on centers, from forged blanks, and the cutter head is quickly adjustable for all sizes within the range of the machine. This adjustment is effected without removing the head from the machine, a development that is a natural outgrowth of the bolt turning machines long furnished by this company for finishing rod and frame bolts.

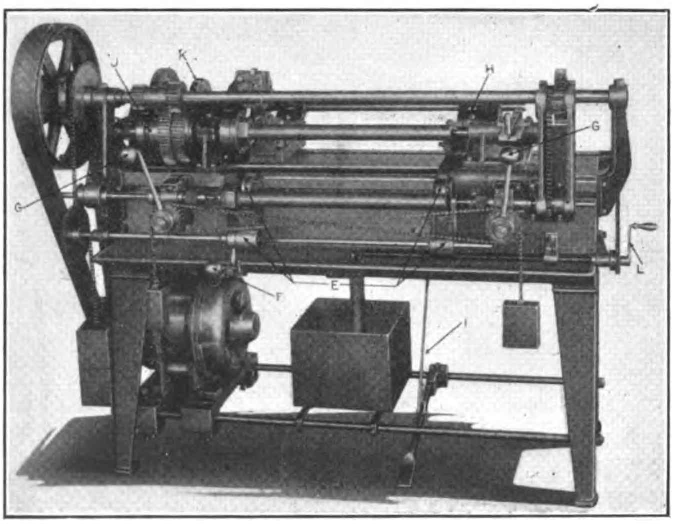


Fig. 2—The Foster Bolt Centering Machine Which Centers and Points the End and Face Under the Head of the Bolt

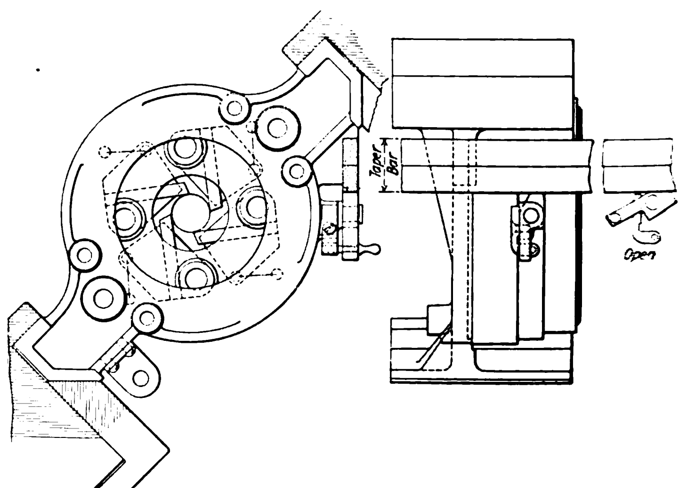


Fig. 1—View of Cutter Head Showing Relation of Cutter Blades to Bolts to Be Turned

The former machines had the disadvantage that separate turning heads must be provided for nearly every size of bolt. These heads required a considerable investment and were

hard to maintain, especially in the case of the heads for taper bolts. On the new machine the bolt is held on centers, with the driving spindle and floating chuck below and the cutter

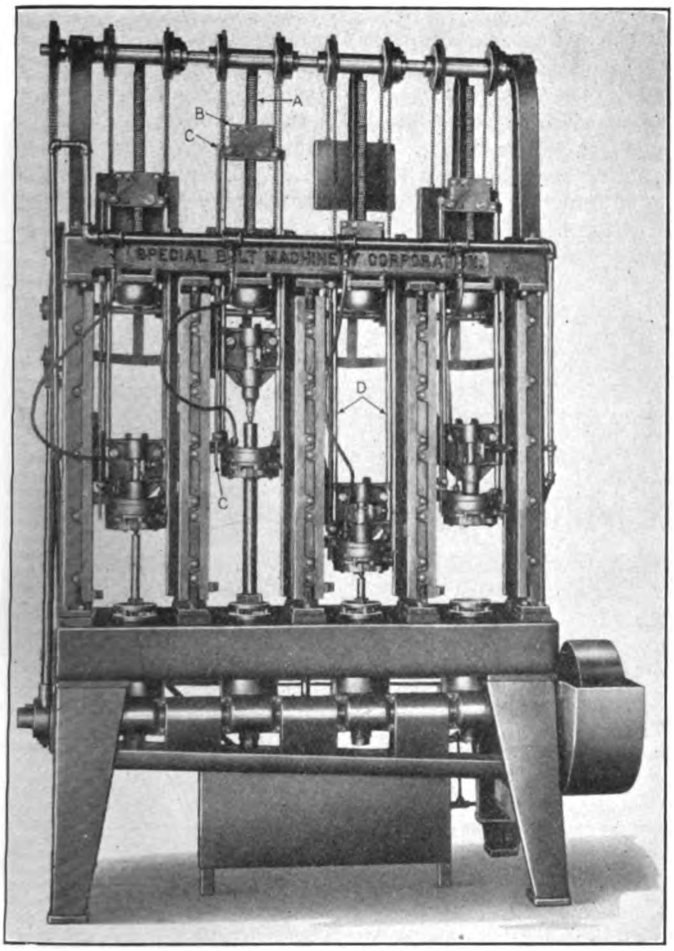


Fig. 3—The Foster Bolt Turning Machine Designed to Turn Bolts on Centers from Forged Blanks

head feeding down over the bolt blank. The cutters are relatively narrow and the inverted arrangement not only permits

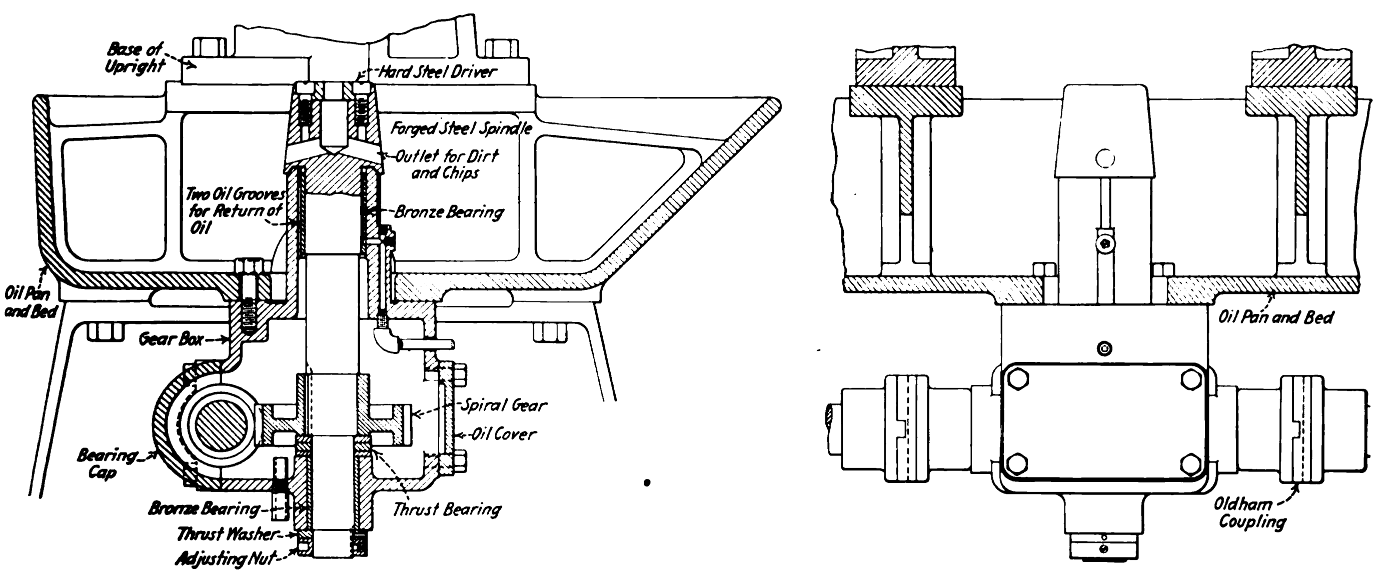


Fig. 4—The Construction of the Bed or Chip Pan on the Foster Bolt Machine

the chips to drop clear of the cutter head directly into the chip pan but at the same time an ample flow of cooling compound can be turned directly on the cutters. The combined result makes for higher turning speed and smoother work.

A plan view of the cutter head illustrated in Fig. 1 shows the relation of cutter blades to bolts to be turned and to the controlling bar which is adjustable from straight to any taper desired within the range of the machine. This bar is hung as a loose pendulum from the upper member of the machine, thus adapting itself to any slight floating of the head in its gibs. The pawl which is attached to the operating ring of the cutter head in front of the taper bar, is in turn backed by a projecting shoulder on the head proper directly opposed to the pawl.

Referring again to Fig. 3, it will be seen that the feed is through the lead screw *A* by means of an automatic nut *B*. From the nut the motion is transmitted through two guided push rods *D* to the cutter head. The nut *B* has a trip rod *C* extending down the left hand side of each station, which trips the feed, at any desired point by coming in contact with a stop adjustably mounted on the left hand housing. To accomplish the return there are two chains attached to the upper ends of the push rods. These chains in turn pass over a spool carrying a friction sufficiently powerful to return the head to its upper position as soon as the feed nut is tripped.

The tailstock which carries the top center is adjustable for the entire length of the guides. The tailstock center and spindle is controlled by means of a wedge which, with a single horizontal motion, moves the center into position and holds it. The wedge is locked in position by a yielding device which follows up the spindle slightly in the event of the center hole being ridged and breaking down after the first few revolutions.

The illustration in Fig. 4 shows the construction of the bed or chip pan. The steel driving spindles are of large diameter and have liberal bushed bearings above and below the main drive gears, which are of steel and bronze and are enclosed in oil tight cases. The main drive shaft is made in sections, connected by the Oldham type couplings, thus making each spindle a complete, detachable unit, which with its gear case can be removed without disturbing any other part of the machine.

To cheaply and accurately center these bolts, an auxiliary machine, illustrated in Fig. 2, was developed, which would center both ends at the same time, and to point the end and face under the head. The bolt blank is first placed in the centering chucks *E* and clamped by the lever *F* on the front of the machine. The center drills are then brought up by means of the hand lever *G*, either right or left hand lever

being used to operate both centers. The centered bolt is then lifted up and placed between the centers *H* on the top of the machine and the foot treadle *I* tripped, from which point this operation is automatic, allowing the operator to center the following bolt.

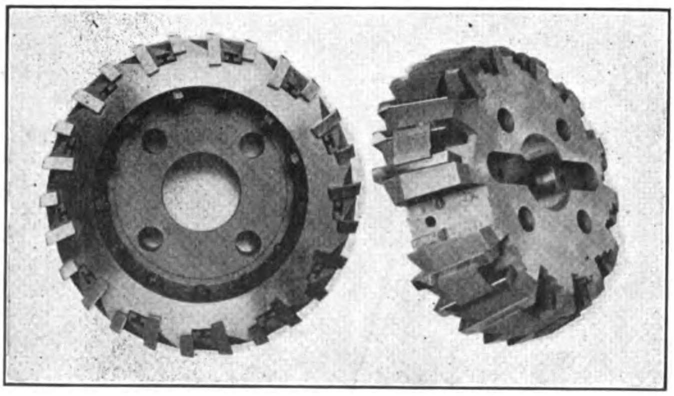
The centering is done by two spindles with a standard centering tool in each, guided in bushings. The left hand spindle is provided with a stop so that this center may be maintained at the same depth in all bolts of the same size, thus fixing the amount faced off the head. The facing under the head is done with a roughing and finishing tool and on the point a form tool is used. All three of these tools are actuated from separate cams on a shaft at the back of the machine. This cam shaft is geared direct to the main spindle. The drive to the main spindle, hence the cam shaft, and the two centering spindles is through a jack shaft extending across the top of the machine. Between the jack shaft and the main spindle there are two changes of speed by slip gear. The main gears on the spindle are loose and provided with a clutch, which starts the operation when the foot treadle is depressed. A timing disk keeps the clutch in engagement until the facing and pointing operation is finished and the tools are returned to their starting position. The rotation of this spindle then ceases until another bolt is in position to be worked on and the treadle is again depressed.

The centering machine will operate on bolts from 6 in. to 25 in. long. To change from one diameter to another it is only necessary to change the driver, which is held on by two spring clamps, and slightly adjust the facing and pointing tools for the new size. To change the length of bolt, the pointing tool slide and its cam, the tail center and the right hand centering spindle are all arranged on one large slide which is brought up to the desired position by means of the screw and the crank, causing all three to move up together and saving time. Each has a small amount of independent adjustment for close setting or to compensate for worn tools. The tools and tool holders are simple and rigid and easily accessible. The machine is mounted on a heavy bed which in turn is mounted on a large chip pan. A compound coolant pump and tank are provided.

Inserted Tooth Face Milling Cutters

MANY inserted tooth cutter bodies are now in use, but trouble is encountered with them when removing metal at high speeds, especially with the Stellite cutting metal because of the resilient hammer blow on the cutting edge and the unusual shocks that the blades, cutter body and holding apparatus received. In an effort to overcome this difficulty a cutter head or body has been constructed by the Modern Tool Works of the Consolidated Machine Tool Corporation of America with all parts hardened because the accuracy of the slots, face and hole in a soft body cannot be maintained in use.

When using a solid cutter it is apparent that the length of the teeth projecting from the body of the cutter must be limited by the strength of the cutting metal, and when this tooth length is worn or ground off the entire cutter, including the body, of which no use has been made, must be discarded. During the life of a solid cutter, however, there is no possibility of a movement of the parts of the cutter from vibration. The entire surface of a solid cutter is hardened, which prevents damage to the clamping faces of the hole

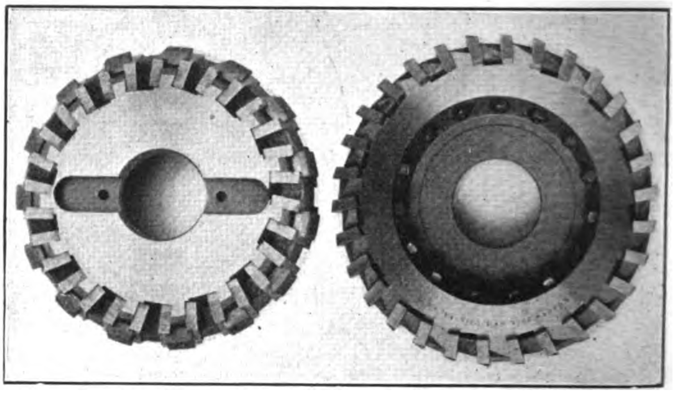


A Face Milling Cutter with the Blades Held in Place by a Two Piece Clamp Drawn into Place by a Taper Wedge Bolt

where it must fit the arbor, so that there is no loss of cutting efficiency because of the cutter not running true on the arbor.

A standard size of slots in a soft body cutter cannot be maintained when driving or placing a hardened blade in and out for adjustment or replacement, thus requiring special shapes and sizes of blades to refit the slots perfectly. When hardened slots are employed it requires greater accuracy and expense to obtain a perfect fit between the slots and blades, and many blades will be broken in the operation of fitting and adjusting. Where any method is employed in securing the blade in place that leaves an opening between the clamps, pin or other apparatus and the face of the blade, or either face of the slot, the effect of the solid cutter has not been maintained.

In the modern cutter head a method of rigidly clamping



A Nine Inch Face Milling Cutter with Stellite Blades Wedged in Place

the blades has been provided which does not require accurate machining of the slots and blades. The head is designed for Stellite cutting metal or high speed blades and has the following features that contribute to its effectiveness. The blades slope away from the largest diameter on a 20-deg. angle, allowing clearance over the clamps for the grinding wheel to pass when sharpening and clearance for two cutters to interlock while running when used to finish a surface of sufficient width to make the use of one cutter impractical. The blades are located in the cutter body at an angle of six degrees toward the line of travel. Slots are milled parallel with the bore when equipped with Stellite metal, with no slope toward the face of the work, which would tend to lead the tools into the work. When high speed blades are used, the slots are milled at a helical angle that insures the proper rake most efficient for high speed steel. A new method of holding the blades is supplied by the use of a two-piece clamp drawn into place by a taper wedge bolt. Each slot of the modern cutter takes two blades, between which a

taper wedge is fitted with clamps bearing on the top of the blades so that when these bolts are pulled home the blades are solidly locked in. Only a socket wrench is required to assemble, since the blades are free until the wedge is drawn into place between the clamps on the cutter. To remove the blades it is only necessary to loosen the nut on the wedge bolt and tap it slightly; the use of a drift is unnecessary.

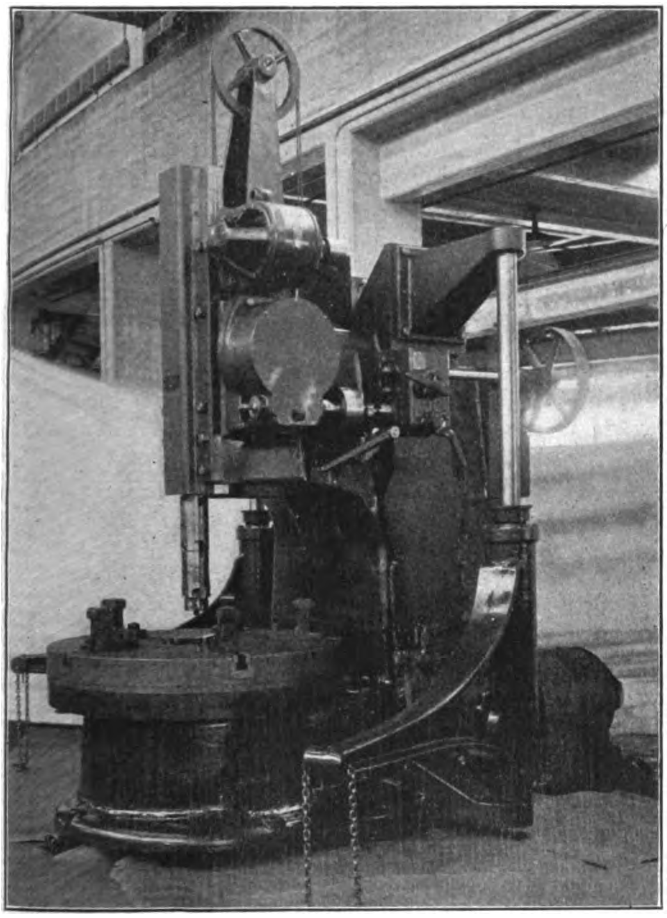
The blades are made with notches in the bottom which fit over a stop pin. This not only backs them up, but in adjusting the blades for grinding, each one is advanced one notch and all are brought out exactly the same distance. No hammer or press is required to locate the blades.

The bottom of the slot will remain true and free from obstructions usually caused by the shearing action caused by driving in a blade improperly fitted. This feature provides against loose blades that may damage the work or break under the cut and cause damage to the cutter body or the work. The cutters are made in two pitches. Type A is known as a coarse pitch and type B is a fine pitch. Both are made in sizes from 4 to 16 in.

A Car Wheel Boring Machine Equipped with a Double Hoist

A CAR wheel boring machine designed for intensive production has recently been placed on the market by the Betts Machine Works of the Consolidated Machine Tool Corporation of America.

The machine is equipped with double hoists, each of the pneumatic type, which are located one on each side of the machine. They are entirely independent, and each of them will swing to the center of the table. This arrangement greatly facilitates loading and unloading the wheels since it permits handling them from both sides of the machine. It has been found in some cases that production on the advanced type car wheel boring machines has been limited by the time required for loading and removing the bored wheels and the application of these double hoists solves this difficulty in a large measure. The machine is arranged for boring only, but may be furnished with an attachment for facing off the hubs.



A Betts Boring Mill Equipped with an Automatic Chuck Which Is Operated by the Rotation of the Table

The main drive is by means of a 20 hp. adjustable speed D. C. motor, all the table speeds being obtained electrically through the motor. The motor is operated by a reversible automatic controller with a push button station placed conveniently for the operator. Starting and stopping the table and opening the chuck jaws are all accomplished instantly by means of a push button control. The motor speed is adjusted by a separately mounted field rheostat which may be placed most conveniently for the operator.

The chuck is of the automatic type, the jaws closing in or releasing the wheels with the rotation of the table as the forward or reverse push button is depressed. The chuck, which grips the wheel tighter as the depth of the cut increases, contains five hardened steel jaws. The table is equipped with a powerful brake operated by a foot treadle which aids in opening the chuck instantly, and is also used for holding the table stationary without releasing the jaws when it is desired to inspect or caliper the work.

In case alternating current only is available, the table speeds are obtained through hardened steel sliding gears running in oil and located inside the main frame casting. The opening and the closing of the chuck is accomplished by means of a large diameter, powerful friction clutch which makes it unnecessary to stop or reverse the motor in order to open the chuck. This feature is provided in order to obtain quick action from the chuck owing to the time required for stopping and reversing A. C. motors where dynamic braking is not available.

A suitable range of feeds for roughing and finishing is provided. They are obtained through sliding steel gears which may be changed while the machine is running. The feeds are controlled by two conveniently located levers which permit the operator to change from the roughing to the finishing feed when the roughing cutter has cleared the work.

The boring spindle is of heavy rectangular section, provided with an adjustable gib for taking up wear. The power rapid traverse to the boring spindle is provided by a separate motor which is controlled by a conveniently located push button for actuating the automatic controller. "Raise" and "lower" buttons are provided for the operator's convenience for selecting the desired movement. The power traverse operates at high speed and quickly returns the boring spindle to the starting position when the wheel has been bored, practically without effort on the part of the operator. An interlocking clutch is provided between the feed and power traverse so that both cannot be engaged at the same time. The boring spindle is also counter-weighted to facilitate hand adjustment.

The upright section of the frame is of massive proportions for withstanding the strains imposed by the heavy cuts and coarse feeds for which this machine is designed. The table has an annular bearing on the bed which is automatically lubricated by means of oil pockets and rollers. It is carried on a spindle which rotates in an adjustable taper bushing with provision for taking up wear and has a heavy retaining ring at the lower end for preventing any tendency of the table to rise under heavy cuts. The table is driven

by an accurately cut heat treated bevel gear and pinion.

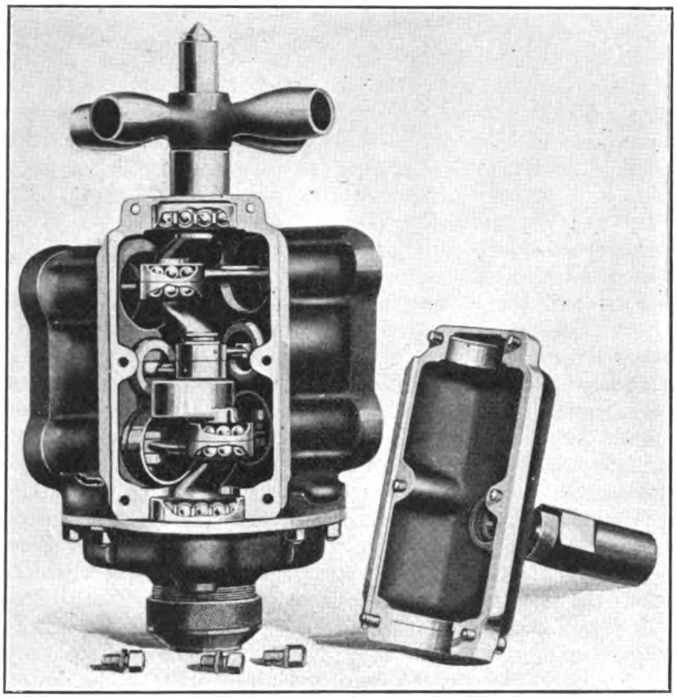
Free chip passage is provided through a large diameter hole in the table and spindle which delivers the chips to a pit underneath the machine so that none can get into any of the working parts. All important bearings receive ample lubrication from separate oiling pipes and tubes. This machine will take wheels of all sizes from 10 to 42 in. in diameter.

A Pneumatic Motor and Portable Grinder

THE Cleveland Pneumatic Tool Company, Cleveland, Ohio, has put on the market an air motor which is designed to meet the requirements of railroad work for drilling, reaming, tapping, flue rolling and setting plain and flexible staybolts, sleeves and caps.

The semi-sectional illustration of the motor shows its unique construction, in that all the moving parts are mounted on ball bearings. The motor is the four-cylinder type, having four single acting pistons connected to opposite wrists of a double throw crank. The wrists of the crank are grooved, hardened and ground to act as an inner ball race, and the connecting rods, the outer ball race.

The four connecting rods each have a ring end large enough to be strung onto the crank. After the connecting rods are placed in position on the crank the balls are then inserted and are held in position by a spring ring retainer.

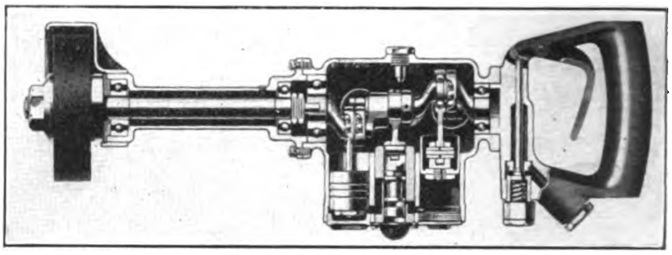


A Pneumatic Motor With All the Moving Parts Mounted on Ball Bearings

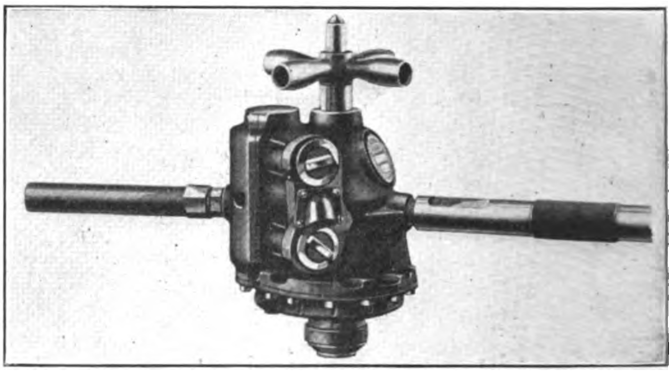
The pistons are screwed in the piston sockets, which in turn are attached to the connecting rods by a floating wrist pin which is provided with oil holes for lubrication. The main valves are of the slide piston type and are operated from eccentrics on the crank shaft. They are placed between each set of cylinders, from which they are separated only by a thin wall in which liberal air ports are provided. The live air is injected almost instantly into the piston chamber, which insures quick motor action and tends to conserve air.

Because of the reduced bearing friction and the added power from the quick delivery of the air to the pistons, a high motor speed is developed. This is transmitted to the spindle through different gearing ratios and an unusually high drilling capacity is said to be obtained. The bearings on the crank and the connecting rods run constantly in a bath of lubricant, as also do the valves and pistons. The gears are housed in chambers opening directly into the crank case and filled with a lubricant, and are so constructed that the lubricant is not driven out of the case when the motor is in action.

The portable grinder embodies the same principle of design as the air motor. The single piece connecting rods contain ball races which operate directly on the crank. These races, as well as the annular ball bearings on the crank and the arbor bearings, are open to continuous lubrication, both in the crank chambers and in the forward quill housing. The arbor is connected directly to the crank and is mounted on annular ball bearings at both ends, the same as the driving crank. This machine can be furnished with either one of four types of throttle handles; namely, an enclosed type with an outside or inside throttle lever; a straight handle with a snap throttle lever, and a straight handle with a twist throttle sleeve.



A Cleveland Portable Grinder with an Enclosed Handle with Throttle Lever Inside

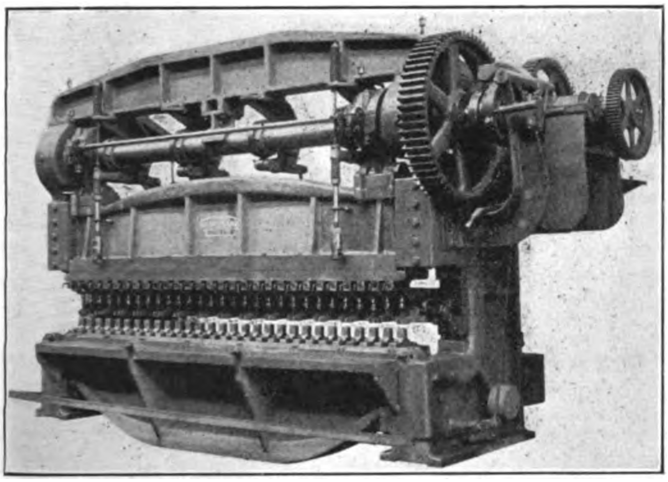


The Cleveland Pneumatic Motor

The body casting of the grinder is split into two pieces, which permits the removal of the entire crank assembly without disconnecting the pistons or the valves from the crank. The piston cups are screwed into the piston sockets and reinforced by a lock nut at the base of each cup. The connecting rods are attached to the piston sockets by a floating wrist pin, which is perforated for lubrication. The grinder weighs 12 lb. and drives a 6-in. emery wheel at a speed of 4,600 r. p. m.

Combination Multiple Punch, Gate Shear and Gap Forming Press

THE Cleveland Punch and Shear Works Company, Cleveland, O., has recently developed a combination punch, gate shear and gap forming press which measures 12 feet 2 inches between housings, has a 15-inch horizontal gap and weighs 40 tons.



The Machine Arranged as a Multiple Punch

The machine, arranged as a multiple punch, is shown in the accompanying illustration. The features stressed by the company are the automatic stripper, a positive jaw clutch for the regular run of punching operations, an adjustment to slide, a friction clutch for forming, patented single-bolt gagged adjustable punching attachments, an interchangeable plate shearing attachment and safety counterweights for balancing the sliding head. All gearing is of steel with cut teeth and heat treated.

The automatic stripper is designed with adjustable trunnions, so that the flat finished face of the stripper fingers will always strike material of minimum and maximum thickness squarely and not in a "cocked" position. This arrangement materially reduces the breaking of punches due to stripping which eliminates a considerable item of expense.

The patented single-bolt adjustment reduces the setting up time for multiple punching. It is stated that one man can do this work without trouble. The steel casting adjustable cup strippers are in an accessible position and may be adjusted or removed from the front of the machine with great facility.

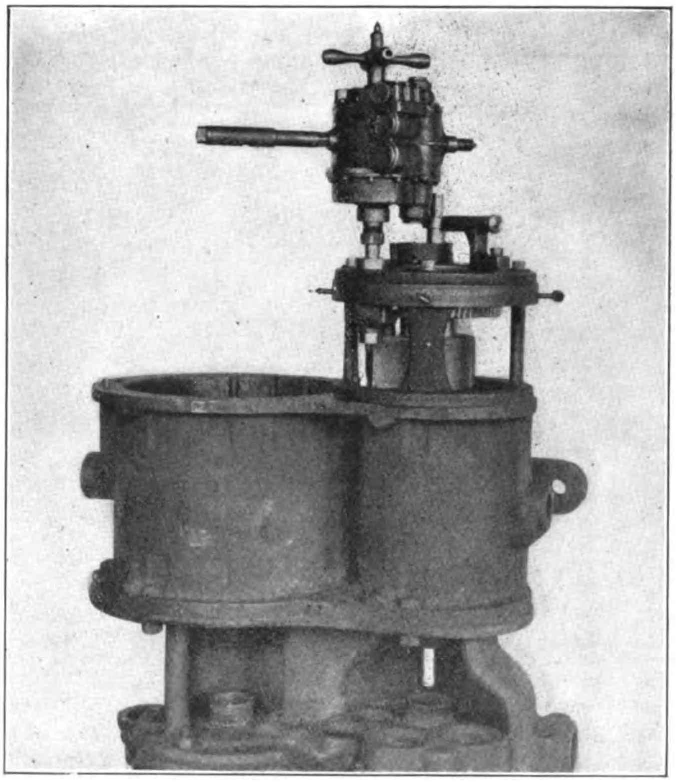
The Underwood Portable Small Cylinder Boring Equipment

A PORTABLE boring bar has been developed by the H. B. Underwood Corporation, Philadelphia, Pa., for reboring the cylinders of locomotive air compressors, reverse gears, cylinders, water heater pump cylinders, stoker engine cylinders, either in the repair shop or while the equipment is in position on the locomotive. This boring-bar is of a simple, compact design that permits its use in close quarters. It is made with fewer parts than previous designs of this company and consists essentially of a bearing plate carrying a boring-bar, driving spindle and feed-screw mounted on a clamping ring, and a cutter-head.

Power for driving the equipment is derived from an air motor, the driving spindle being provided with a Morse taper shank to fit the motor. The spindle drives a pinion which mashes with a gear keyed to the boring-bar. Keyed to the feed-screw is a feed gear which meshes with a reverse gear journaled on a pin centered in the boring-bar. The reverse gear turns freely on this pin unless prevented by the engagement of a feed pawl, which holds the gear stationary relative to the bar and causes the feed gear to revolve the feed-screw and advance the cutter-head into the work. The cutter-head is rapidly returned to the top of the cylinder by placing the motor on the shank of the reverse gear.

In applying the equipment, the pilot guide is screwed on the stuffing-box of the cylinder, the bar placed in the cylinder, and the clamping ring securely fastened to the top flange of the cylinder by studs and nuts, as shown in the illustration. Any inaccuracy in the position of the studs can be quickly corrected by means of four thumb-screws in order to set the bar in alignment. The tool is adjusted and held rigidly in the cutter-head by simply tightening a collar screw and, if desired, may be as readily released when the cutter-head is at the lower end of the cylinder. In boring cylinders, the use of calipers is entirely dispensed with, a gage furnished with each bar providing a simple method of setting the tool to the required position.

The time required for reboring both ends of a 9½-inch air pump with this equipment, is as follows: Setting up on steam end, 7 minutes; setting up on air cylinder, 8 minutes; reboring time, 16 minuates; removing equipment, 7 minutes; reboring air cylinder, 15 minutes; removing equipment, 7 minutes; total time 60 minutes. The tool is regularly made in sizes suitable for reboring cylinders and bushings of standard compressors, and may be adapted to other sizes by changing the cutter-heads. The weight of the equipment having a capacity for boring cylinders from 8½ in. to 11 in. in diameter and of 12 in. stroke, is about 240 lb., not including the weight of the motor.



A Compact Cylinder Boring Equipment Adapted for Work in Close Quarters

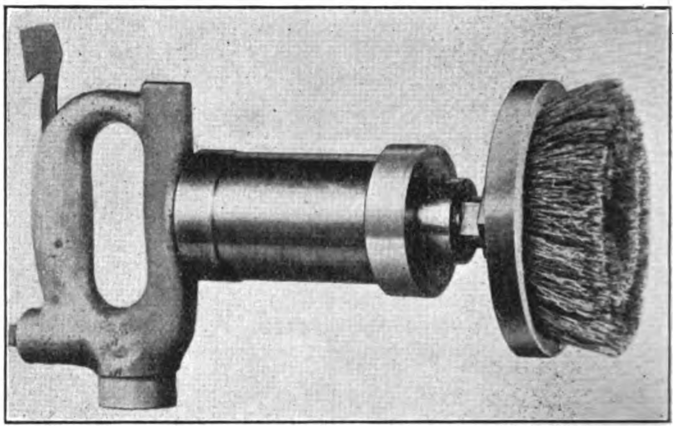
A Pneumatic Surface Cleaner for Steel Plates

A PNEUMATIC surface cleaner has been developed by the Liberty Manufacturing Company, Pittsburgh, Pa., in response to the demand for an air-operated tool to remove rust, paint and scale from steel plates and flat surfaces. The machine is adapted to any service requiring the rotary motion of a steel brush.

The equipment consists of an air-operated motor, with an aluminum valve handle and a steel wire brush. A sight feed lubricator for distributing oil to the motor and a connection for the operating hose are also furnished. The motor is simple and rugged in construction. Air pressure acts behind a pair of semi-balanced blades which are inserted in a long, hardened steel shaft mounted eccentrically in the cylinder. An air pressure of 50 to 75 lb. is recommended for operating the cleaner.

A 5-in. steel wire brush, having a large working surface, is used. In operation the brush is held flat against the surface to be cleaned; it is not necessary to tilt the cleaner at an angle. The design of the brush is such that it will not lose its bristles, but after the bristles have been worn down, it can be replaced.

The complete outfit weighs about nine pounds, and has an approximate overall length of one foot. The valve arrangement at the rear makes the cleaner easy and convenient to control.

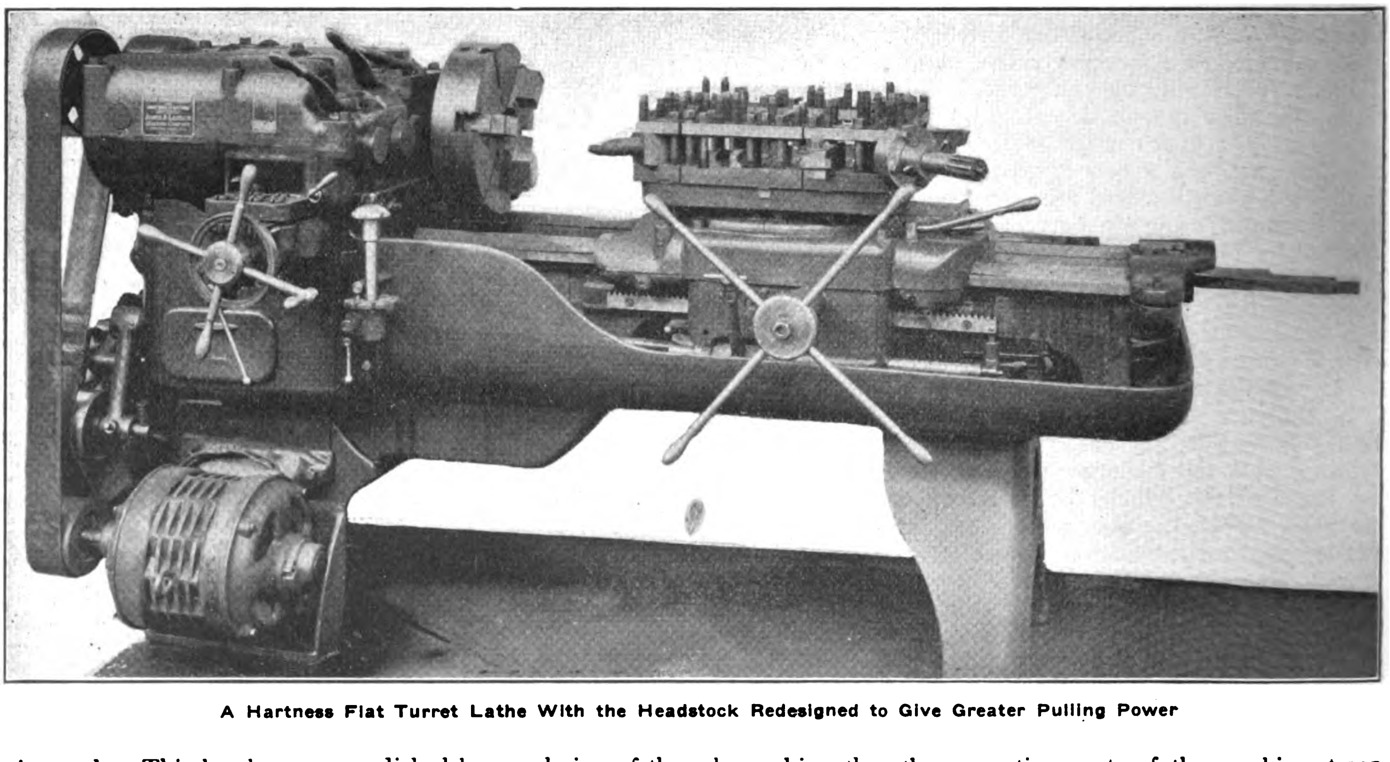


The Liberty Surface Cleaner with a Steel Wire Brush to Clean Flat Surfaces

The Hartness Flat Turret Lathe for Chucking Work

THE threading of studs and bolts is one of the commonest jobs encountered in the average railroad shop. The Jones & Lamson Machine Company, Springfield, Vt., has recently developed a new flat turret lathe to handle such work in locomotive repair shops.

The primary object in redesigning this machine has been to secure sufficient pulling power to satisfy present needs, and also to leave a margin for future developments of cutting tools. This has been accomplished by a redesign of the headstock, which has been equipped with a new type of spindle bearing and a ball thrust bearing. The shafts are shorter and stronger, and are also mounted on ball bearings. The gears are machine cut from chrome-nickel steel and are heat treated. The clutch is of the friction type with which the selective speeds may be changed under load. The new steel multiple disc friction clutches give ample pulling capacity so that when the machine is equipped with a 20 hp. motor and a 5-in. belt, it will not slip when pulling heavy cuts.



A Hartness Flat Turret Lathe With the Headstock Redesigned to Give Greater Pulling Power

The pulling power in the headstock is only made effective by making the other operating parts of the machine strong enough to take the strains which are set up by such heavy cuts. The feed mechanism, the saddle, the turret, the apron and the lathe bed itself have, therefore, all been redesigned

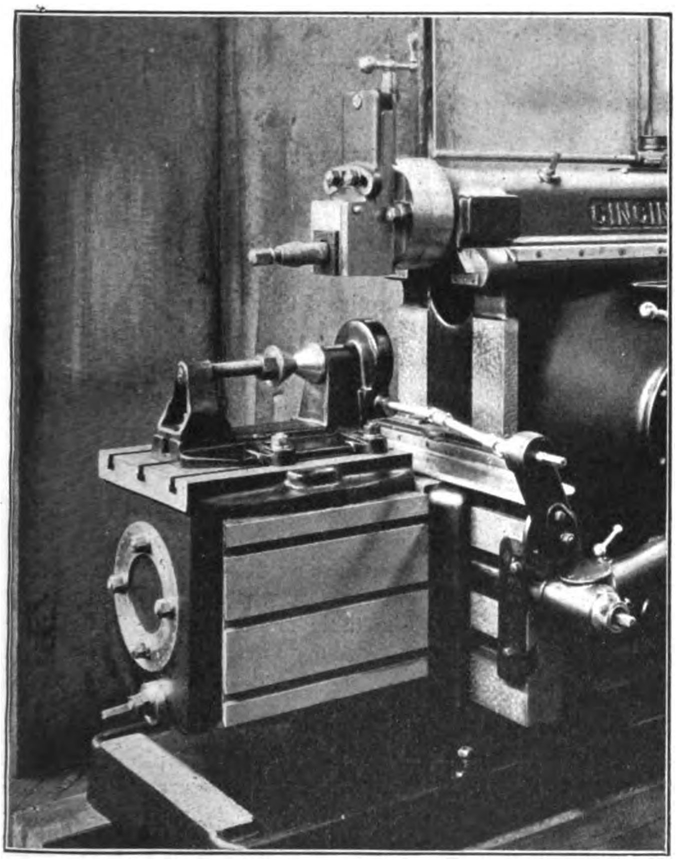
to conform to the requirements of the improved headstock.

There are many minor improvements made on this machine. A few of them are as follows: A more easily operated feed lever; an improved center stop lever; a more conveniently placed speed change control; a start and stop lever to take the place of the old shipper rod. An adjustment has also been added for timing the indexing without removing the turret.

The 17-in. swing flat turret lathe illustrated can be used for turning, facing or boring, and other operations on parts held in a chuck, face plate or fixture. Its square turret, eight tool positions and heavy drive make it suitable for work up to the full capacity of the machine, including parts requiring more or less elaborate machining. This machine swings as follows: Over vees facing clear across, 17½ in.; over vees on centers, 21 in.; over vees facing 4 in., 18 in.; over saddle facing clear across, 16½ in.; over saddle on centers, 18½ in.; over saddle facing 4 in., 17 in. The head travels 8 in. from the center away from the operator and 1½ in. away from the center toward the operator.

The Cincinnati Tool Room Shaper

A NEW line of shapers, developed especially for tool room use, is now being manufactured by the Cincinnati Shaper Company, Cincinnati, Ohio. The machine is built up essentially of the main elements of the Cincinnati Climax Shaper, which was described in the December, 1923, issue of the *Railway Mechanical Engineer*. The tool room shapers are built in seven sizes: namely, 16 in., 20 in., 24 in., 28 in., and 32 in. heavy duty type, and in two sizes—20 in. and 24 in.—of the standard type. The machines include an eight-speed internal transmission, completely automatic and visible oiling, a smooth cam-actuated feed in place of the abrupt ratchet feed, convenient controls to all movements, and improved guards to ramways and cross rail.

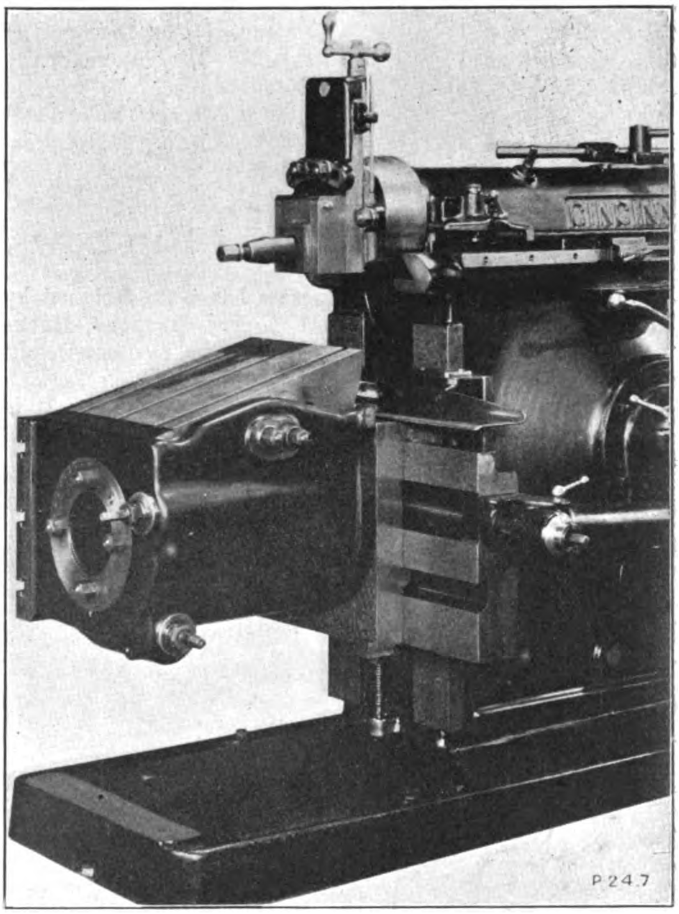


The Method of Driving a Cone Arbor Attachment

A constant speed motor is used in all cases, as the internal transmission provides for eight speed changes within the column. It is mounted at the rear of the machine, and is bolted to the base and column. It is belt-connected to the main driving pulley on the shaper, the size and speed of which are such as to provide for 1,800 r. p. m. motor. The use of a ball bearing, counter-weighted idler pulley on the slack side takes up any stretch in the belt automatically, and eliminates any necessity for an increased arc of contact on the pulley as the load increases. The belt is completely guarded.

The striking feature of this shaper is the universal swiveling table with which it is fitted. This table is arranged to swivel about a heavy trunnion which is the full length of the table and cast solid with the apron. A worm and worm wheel, operated by a crank wrench, revolve the table to any angle or position desired, the angular position being indicated on the graduated plate on the front end of the trunnion.

The table has one solid face, similar to the standard shaper table. The second face, however, is a rocking top set well into the body of the table, and has a movement of 15 deg. either above or below the horizontal on an axis at right angles to the trunnion. This movement is controlled also by a crank through a worm and worm wheel, the position being indicated by graduations. Clamping means are



The Cincinnati Shaper Equipped with a Universal Swiveling Table

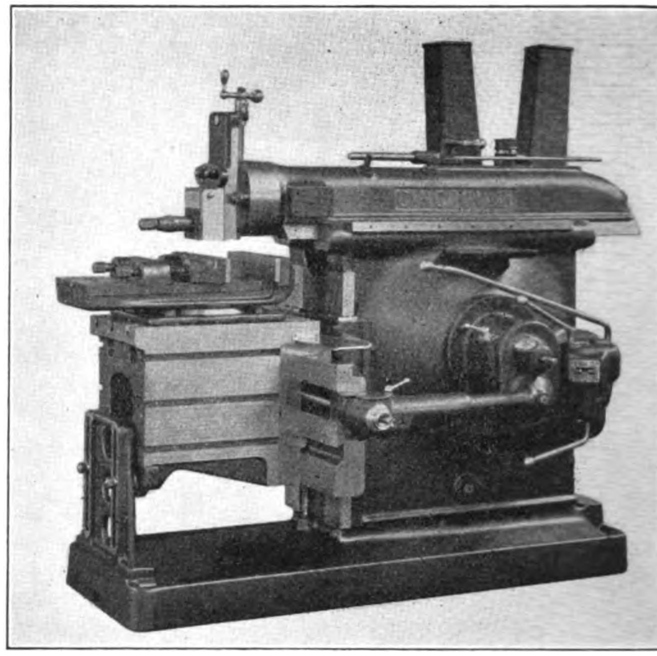
provided for holding this tilting top in any position and at the same time insuring a solid bearing for it in the body of the table. There is a marked contrast between this and the former method of supporting tilting members on hinges at one end and jacks at the other. In adjusting this rocking surface to various positions, there is no change in the mean distance between the table and the tool post so that no loss of working distance under the tool occurs in any position at which the table may be set.

The table is furnished without an outer support, avoiding the cost and inconvenience of a complicated member on a class of work where it is not generally needed. Instead, it has been made of unusually heavy construction, the apron bearing on the rail, for instance, being 6 in. wider than that of the standard box tables on the Cincinnati Climax Shapers. This table has been tested to carry a 2,000 lb. load without binding on any of its sliding surfaces, a feature of value in handling heavy work.

Either single or double screw vises are furnished with this shaper. The double screw vise has the advantage of clamping taper pieces without the use of extra jaws or shims, while the single screw offers the advantage of a little faster operation. One wrench only is required for the vise, tool post screw and various other clamping nuts for adjusting the shaper to its work. One valuable feature of both these vises is the design of the swiveling base which uses only four bolts for both swiveling and securing the vise to the table. This permits a very material reduction in the height of the vise.

The machine is provided with an automatic power feed for the head with a ball lever for engaging or disengaging this movement. Means are provided for automatically stopping the down feed at any desired depth.

Various attachments such as index centers, circular feeding table, and cone arbor are furnished. The method of driving these attachments is illustrated on the cone arbor shown in the illustration. In this arrangement what was the cross feed engagement lever now becomes the control lever for the cone arbor, the cross feed being actuated by hand as needed.



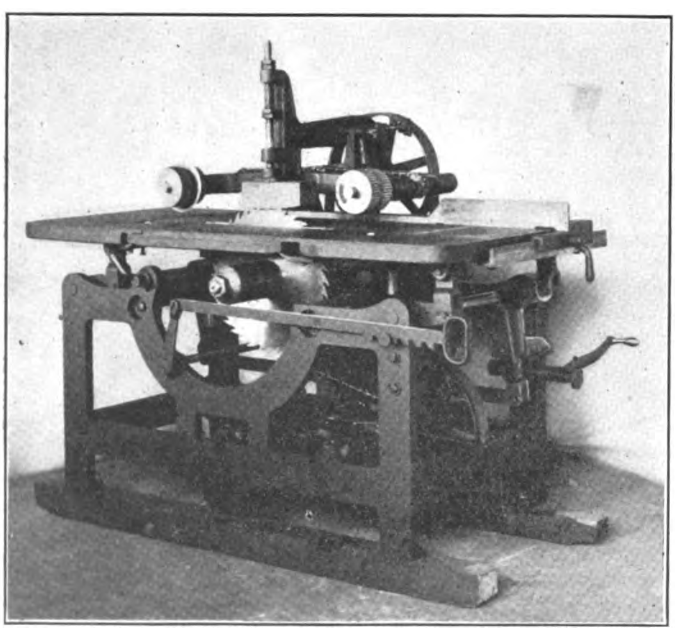
The Cincinnati Shaper Equipped with a Double Screw Vise

Speeds are furnished up to 138 strokes per minute for fast work in short strokes. There is also a range of feeds from .010 in. to .170 in.

A Power Feed Rip Saw Requiring Small Floor Space

A POWER or hand feed rip saw has been designed by the American Saw Mill Machinery Company, Hackettstown, N. J., for plants requiring a medium weight machine of large capacity.

The ripping guide slides are on a flat steel bar. It is equipped with a handy locking device, and may be entirely removed by releasing the clamp screw. Provision is made for ripping 18 in. between the guide and first saw or 26 in. between the guide and the saw when placed at the outer end of the mandrel. The table is provided with a graduated index scale for setting the guide. It measures 32 in. wide by 64 in. long, is heavily ribbed and accurately planed and fitted.



A Rip Saw for Plants Requiring a Medium Weight Machine of Large Capacity

A removable plate on the outside over the mandrel provides for easy access to the saw. A wood plate or throat piece may be substituted when gang saws are used for ripping narrow materials. The mandrel is 1 15/16 in. in diameter and is turned to 1¾ in. at the saw fit. By removing the plate or the throat piece, the saw may be quickly taken off. There is a space of 8 in. between the inside and the outside collars and a set of fill-up collars is provided. One or more additional saws may be used for ripping slats, pickets and handle stock.

The feed rolls are 5 in. in diameter, 4 in. wide, are corrugated and made in two sections. A feed spur is provided to work between the front feed roll sections and a divider between the rear roll sections which may be removed when not needed. Smooth feed rolls may be furnished when preferred. The feed rolls are carried in adjustable frames and are adjusted independently of each other. They are prevented from dropping below a desired point by means of convenient adjusting screws. They may be quickly raised or lowered to suit the thickness of stock. By locking the swing frame which carries the front roll, the entire weight of the feed mechanism is on the front roll, making a very powerful feed for heavy work. The entire feed mechanism

may be raised and locked in position out of the way for hand ripping.

There are three feeds which are 41 ft., 78 ft. and 156 ft. per min., and by a change of one feed pulley, three additional rates of feed may be obtained. The hold down for short stock is under spring tension and may be raised to clear the work. It also acts as a protection for the operator against accidents.

The saw furnished is 20 in. in diameter and projects 6⅜ in. above the table when it is at its lowest point. The table may be raised 4½ in. by means of a convenient crank, and may be locked in any position. The mandrel pulley is 8 in. in. diameter by 8 in. face measurement with a speed of about 1,900 r. p. m.

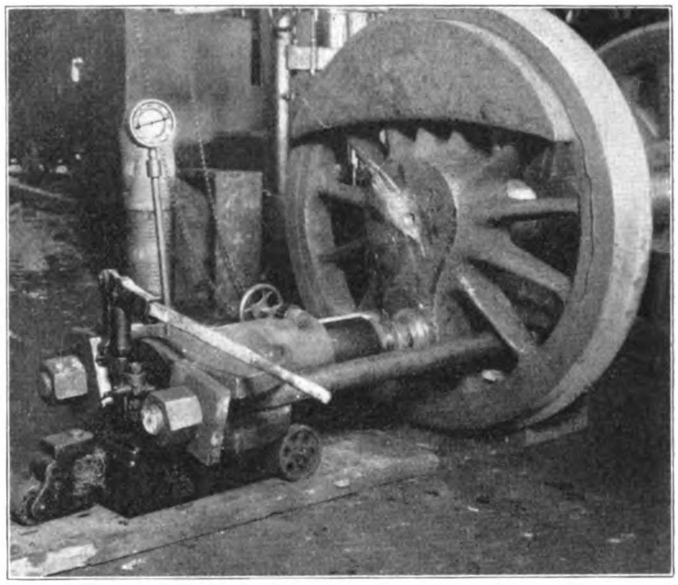
A motor which will furnish from 10 to 20 hp. is recommended to drive this machine.

Portable Hydraulic Crank Pin Press

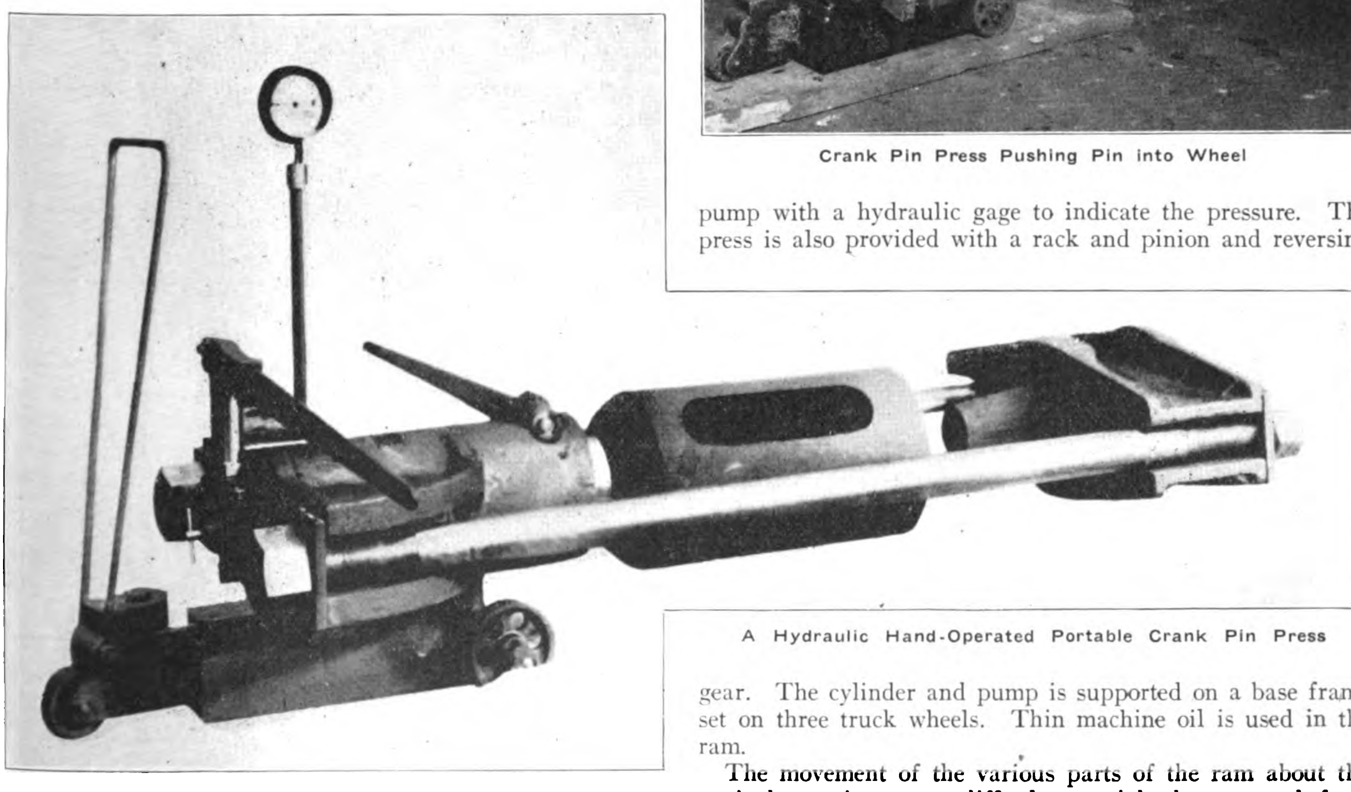
A TOOL which has demonstrated its value in railroad enginehouse service for forcing crank pins and which is now being more generally introduced for this purpose, is shown in Figs. 1 and 2. This press, made by the Charles F. Elmes Engineering Works, Chicago, has been designed especially for removing and applying crank pins without removing the driving wheels from under the locomotive. Owing to the ready portability of the press, however, it can be used anywhere, either in the enginehouse or in the locomotive back shop.

The arrangement of the press for removing crank pins is illustrated in Fig. 1. The two bars of the press extend between the driving wheel spokes, the sleeve covers the crank pin, and the extension on the yoke backs the crank pin out into the sleeve on operation of the press. For applying the pin the yoke or resistance beam is reversed, as shown in Fig. 2, the sleeve dispensed with and the pin readily forced in. The use of this plain yoke resistance beam makes the press serviceable for a variety of other operations such as those of applying or removing rod bushings, driving box brasses, etc.

This machine is made in sizes of 100 and 200 tons capacity, the stroke of the ram in each case being 12 in. and the distance between the bars being, respectively, 12 in. to 21 in., and 16 in. to 21 in. The distance from the ram to the resistance head in both presses is 3 ft. 2 in. and the height of the center of the ram from the floor is 11¼ in. The pressure is obtained by means of a heavy-duty, hand-operated pump with a hydraulic gage to indicate the pressure. The press is also provided with a rack and pinion and reversing gear. The cylinder and pump is supported on a base frame set on three truck wheels. Thin machine oil is used in the ram.



Crank Pin Press Pushing Pin into Wheel



A Hydraulic Hand-Operated Portable Crank Pin Press

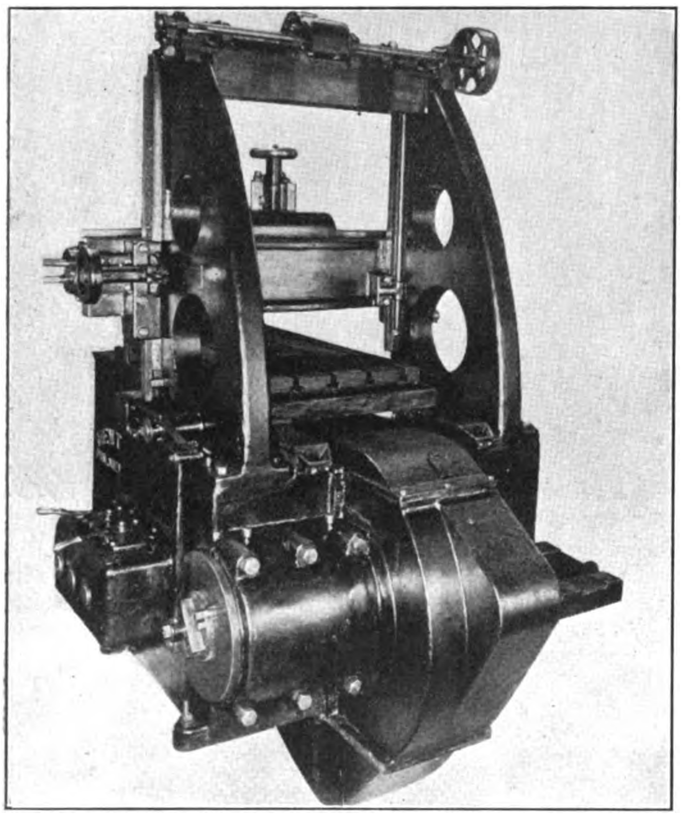
The movement of the various parts of the ram about the enginehouse is not as difficult as might be expected from the illustrations. The main part of the press can be readily moved on the three-wheel truck on which it is mounted. The sleeve spacer and bars are readily detached and can be moved separately on ordinary hand trucks used for transporting small locomotive parts. The time required to set up one of these presses is approximately 20 min. for two men, and the normal time required to press out a pin is about 5 min.

A 40-Inch Stroke Crank Planing Machine

IN railroad repair shops there are to be found a number of single-piece jobs which exceed 32 in. in length. The Newton Machine Tool Works of the Consolidated Machine Tool Corporation of America, Philadelphia, Pa., has built a 40-in. stroke machine to take care of such work.

This machine was primarily designed for machining cross heads, driving boxes, shoes and wedges, rod and driving box brasses and other short stroke work which otherwise would have to be done on a planing machine. It combines the features of a planing machine, such as rigid uprights, an adjustable cross rail and a tool slide, with the one desirable feature of the crank shaper, namely, a fixed stroke at varying speeds which are of sufficiently wide range to take care of the machining of bronze, iron and steel.

The machine has a number of operating conveniences. One of these is a brake and clutch control which permits the stopping, starting and jogging of the table for tool-

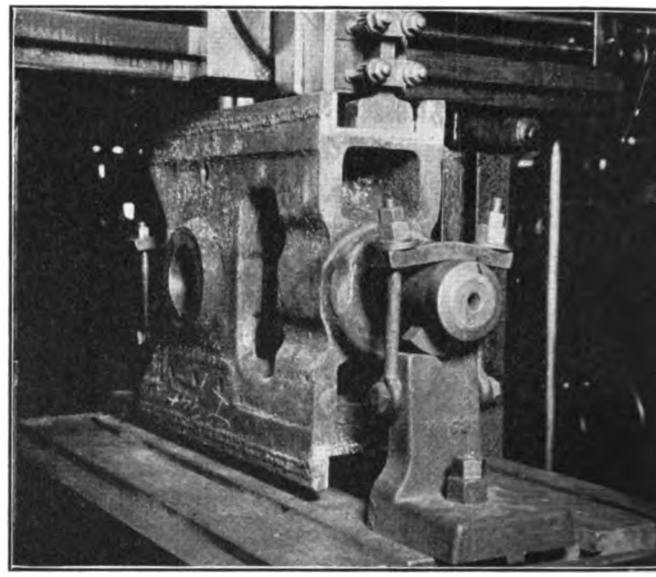


A Rear View of the Newton 40-Inch Planer

setting by means of a self-locking lever which eliminates any possibility of the machine starting up and endangering the operator. The stroke adjustment is made by a small steel pinion meshing with a forged steel ring gear, bolted and dowled to the friction, and on which is mounted a dial graduated in inches to indicate the length of stroke desired.

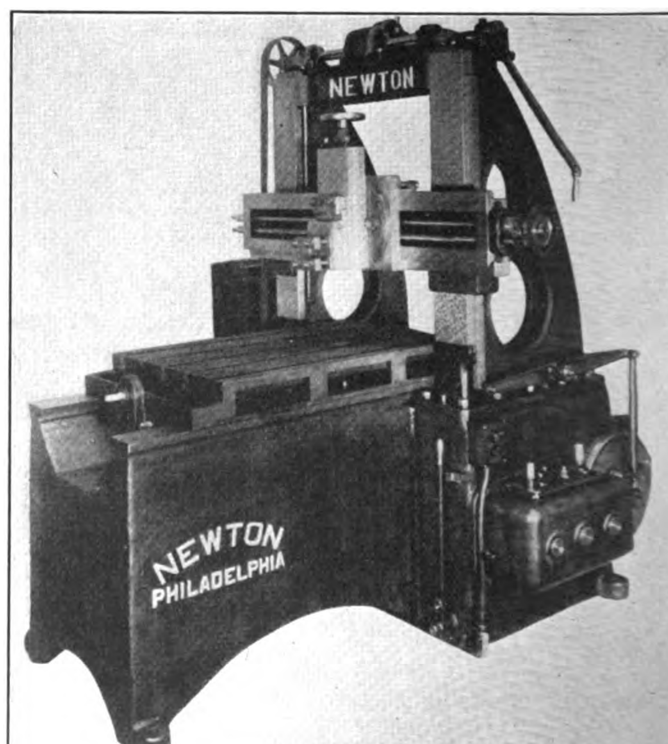
The table is driven by a helical pinion meshing in a large bull gear. Into this gear is fitted the friction stroke adjustment disc which carries the crank-pin that actuates the rocker arm. All gears are fully enclosed to run in oil. The table is of double plate construction, five inches in depth over the bearings, with five machined tee slots and a chip pan at each end. The scotch yoke, which is used for driving the table, gives a relatively uniform cutting speed, with the advantage of a slow starting speed and a quick return which is in the ratio of $1\frac{3}{4}$ to 1. The table has a 20 in. adjustment for positioning the work, which can be done while the machine is running, by means of a screw, and provision is made for solidly clamping for the cutting operation. Six changes of speeds are provided through a gear box of the sliding gear type, all gears being hardened and fully enclosed to run in oil.

The cross rail is strengthened by increasing the section



Machining a Crosshead on a 40-Inch Stroke Newton Planer

and is securely fastened in position by a square clamp on either side which has been increased in width. It is adjusted by power through the table lifting screws, and is of a deep box section gibbed to the uprights for side cutting,



A 40-Inch Planing Machine Adapted to Railroad Shops

with double strips for clamping in position. The clamping arrangement on the saddle and vertical slide have both been improved to insure more secure fastening. The clapper box and clapper are of forged steel instead of cast iron. A fric-

tion clamp is fitted to the cross feed screw to prevent oscillation when feeding.

The base is a box-type one-piece casting with closed top, providing two surface bearings for the table, with angular side bearings and take-up gib. The base casting is stiffly ribbed. The uprights are box-section castings, 28 in. in depth with 6½-in. faces and are bolted and doweled to the base and braced at the top by a deep section I beam.

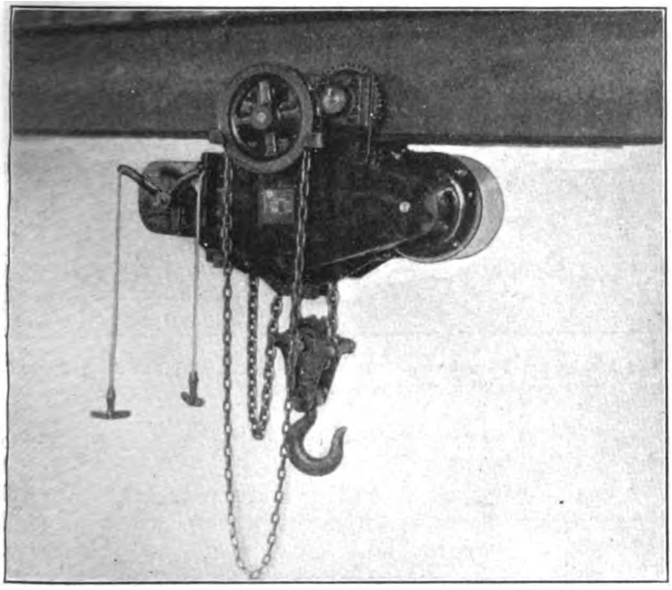
The vertical movement of the tool slide is equal above and below the bottom of the rail so that the amount of overhang can be reduced to a minimum. The swivel is graduated 35 deg. each way. The slide has a hand vertical adjustment which can be made at the head or from either end of the cross rail. A hand cross adjustment can be made from either end of the rail. Power feed is provided to the tool slide in all directions, operating on the return stroke of the table. It is controlled by a ratchet box on the operating end of the cross rail.

All driving bearings are bushed, the important ones with bronze, and all gears and moving parts are either fully enclosed or covered so that the machine will meet the most rigid safety requirements.

The drive is by a 10-hp. 1,200 r. p. m. motor or single pulley through a change gear box to the helical driving gear, which is 4½ in. face and 37 in. in diameter. The face driving gear is carried by an integral hub having a bearing 14½ in. in diameter by 19¼ in. in length. The driving pinion is supported between bearings.

An Electric Hoist Requiring Small Head Room

AN electrically operated chain hoist adapted to the rapid handling of light material has been placed on the market by The Clinton E. Hobbs Company, Boston, Mass. The hoist has been constructed to permit its installation in locations where only low head room is available.



A Hoist Adapted to the Rapid Handling of Light Material

The hoist is of steel construction and completely enclosed. The main drive is by means of a roller chain driving through a heat treated steel cut pinion and sprocket. The hoist is always in balance with or without a load. The center of support is directly over the center line of the load chain. It is lubricated by the Alemite system. This system provides a main reservoir to oil tight main gear case and distributes the oil to all internal parts which greatly helps to reduce frictional resistance.

The machine is equipped with three different types of brakes. The first type locks the load against downward travel; the second provides the lowering friction and has ample surfaces for the dissipation of the heat generated during the lowering, and the third is an external automatic band brake which prevents the drifting of the load when the current is shut off. This brake is adjustable against a spring which actuates it.

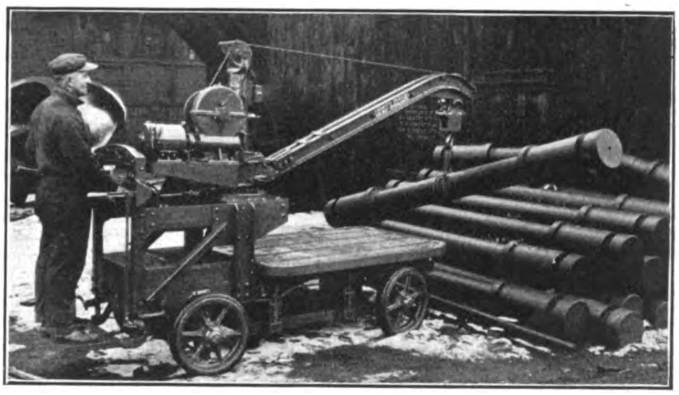
The hoist is suspended by two heavy steel plates which directly suspend the chain sheave bearings, relieving the hoisting mechanism of all load stresses and providing a steel suspension for the load from hook to hook. This construction makes these hoists applicable to any type of trolley or upper support. Any method of suspension desired can be furnished but the three standard types are hook suspension, plain trolley suspension and geared trolley suspension.

The hoist is provided with an automatic stop at the top of the travel that will reverse the motor if necessary, which produces ample protection against over travel. This stop is self-resetting. The hoist has a factor safety of six throughout.

An Industrial Crane Truck With a Lifting Capacity of 1,500 lb.

A CRANE truck with a lifting capacity of 1,500 lb. which will carry a platform load of 4,000 lb., has been built by the Crescent Truck Company, Lebanon, Pa. The boom swings through an arc of 180 deg. so that it can pick up a load on either side or one end of the truck. The crane is of a compensating type with four fixed positions which is operated by a General Electric motor through a worm gear reduction drum. The power unit is of the worm-driven type, and is operated through a standard drum controller, with a circuit breaker attached. The truck has a sufficiently small turning radius to permit it to enter the side door of a standard box car.

Some of the dimensions of the truck are as follows: Load platform, 66 in. by 44 in.; height of platform above floor, 24½ in.; over-all length, 9 ft. 3 in.; length of wheel base, 4 ft. 10 in., and diameter of head, 36 in.



A Crescent Truck with a Boom Which Swings Through an Arc of 180 deg.

The Pratt & Whitney 13 in. Model B Lathe

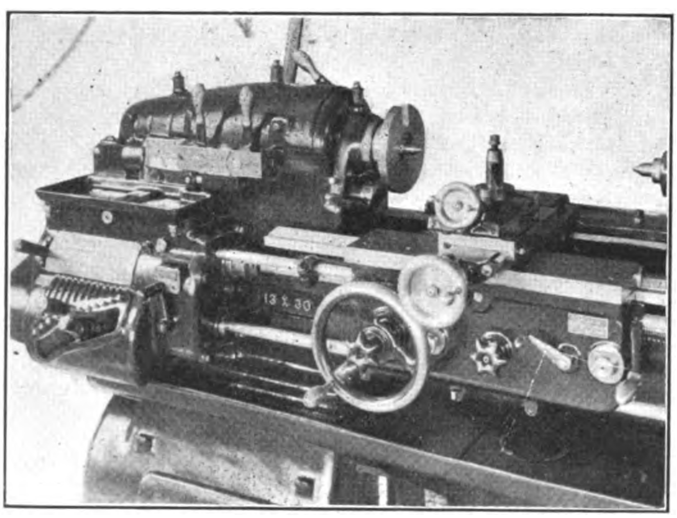
THE Pratt & Whitney Company, Hartford, Connecticut, has recently placed on the market a new 13 in. lathe of the Model B type, which is newly designed throughout. The lathe swings 13½ in. over the bed and is available with beds 6 ft. and 7½ ft. long. The maximum distances between centers are 32 in. and 50 in. respectively, for the geared head and 30 in. and 48 in. for the cone head.

The Model B lathe is designed primarily for motor drive. By placing the motor in a cabinet leg beneath the headstock, it is not only out of the way but is so far below the center of gravity that vibration from this source is practically eliminated. A three-horsepower motor is the regular equipment recommended for the machine and it is regularly equipped with a push button control, low voltage protection and full electrical equipment.

The drive is by belt to the main drive shaft located at the rear of the machine and is geared from there to the headstock and feed mechanism. A friction clutch operated by a convenient shoulder high control rod running the length of the bed is used for starting and stopping the machine without stopping the motor. The clutch is a standard Johnson friction clutch running in oil.

The geared headstock is a new symmetrical design which characterizes the model B lathes. The speed changes are handled by convenient speed change levers from the front of the headstock, and a range of eight spindle speeds is provided from 18 to 525 r.p.m., which is sufficient to cover all the usual classes of work for which this machine is adapted.

Hardened and ground gears are used in the headstock. These gears are of chrome vanadium steel and are cut by



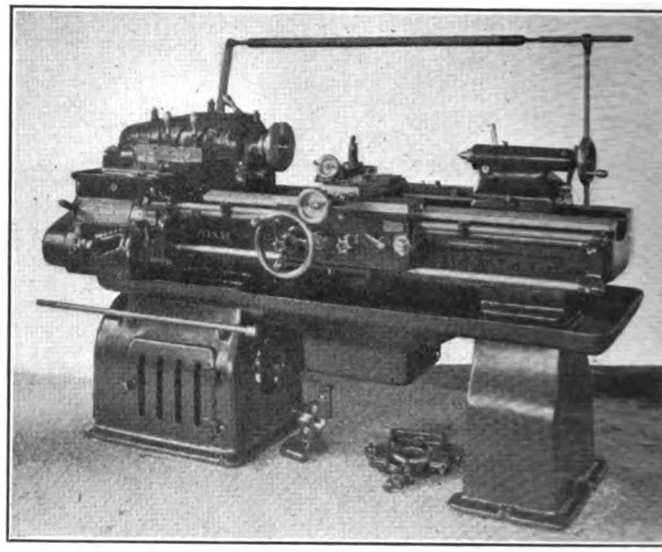
The Pratt & Whitney Lathe With the Operating Levers Conveniently Arranged

the Maag system, providing quiet and smooth operating. The back gears are situated beneath the spindle and are operated by an eccentric lever beneath the spindle nose which gives them a vertical motion for engaging and disengaging. This location completely does away with overhanging part, and the result is a compact and symmetrical headstock which does not in any way hinder the maximum amount of light from reaching the work centers.

The 13 in. lathe is available either with motor drive or single pulley belt drive when the geared head is used. The machine is also available with a standard cone head using a four-step cone pulley and countershaft. The back gears are placed beneath the spindle as in the geared head. An additional feature is the hand brake for quickly stopping the spindle. It is operated by a broad lever placed in the same position that the operator formerly used in placing his hand on the cone to stop the spindle.

The hole through the spindle is 1 5/16 in. in diameter, and the taper hole in the nose is ground to a No. 13 Jarno taper. The spindle nose has both flat and tapered seats in addition to the threaded portion so that an accurate face plate seating is always assured.

The feed gear box is designed so that a rocker lever and a ratio lever work in conjunction with a direct reading index plate, and any desired feed or thread per inch may be instantly set by placing these two levers in the correct relation to the one plate, which eliminates the reading of



The Motor for This Lathe Is Located in the Cabinet Leg Beneath the Headstock

changes. There are 36 feeds ranging from .0012-in. to .0665-in. per revolution of the spindle.

A lead screw and a feed rod are provided. A small gear shifting device is so arranged that when the feed rod is being used the lead screw is idle and vice versa. This reduces the wear on the lead screw to a minimum. A stop and reverse rod runs the length of the bed, which is so placed that it will protect the lead screw from damage from falling tools or work. This rod forms a very convenient method of controlling the feed of the tool.

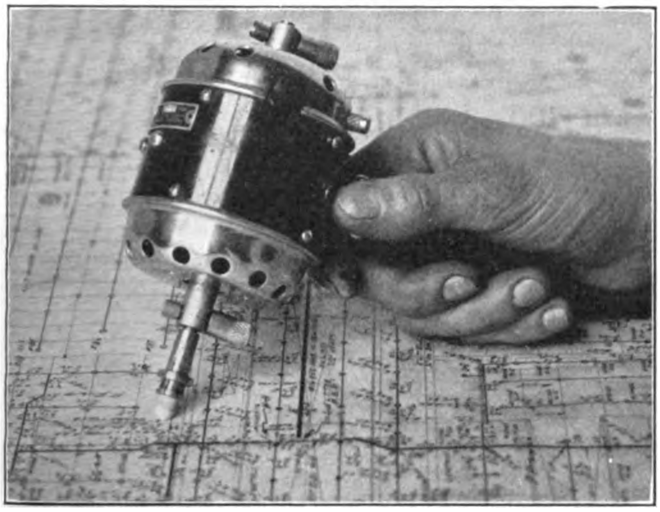
The apron is of the standard double wall construction and is so designed that no bevel gears whatever are used. Spur gear and worm drives carry the longitudinal and cross feeds to the carriage slide. The usual hand wheels and power feed knobs are provided and in addition a thread chasing dial allows the lead screw nut to be easily engaged at any one of four positions per revolution without hunting around to pick up the thread.

A quick withdrawing device for convenient threading has been incorporated in the 13-in. lathe, which consists of coarse and fine threaded screws so arranged that either one may be engaged by the simple tightening of one of two bolts. When engaged, this device allows the tool to be completely withdrawn from the coarsest thread by a quarter of a turn of the cross feed hand wheel.

The handwheel on the compound rest is mounted at an angle to afford knuckle clearance, and to enable the micrometer dial to be more easily read. Other features of this machine are the tailstock with its wedge locked and graduated spindle, the box form of bed with the two cabinet legs, and the general ruggedness of design throughout. A complete line of additional equipment is available.

An Electric Eraser for Use in the Drafting Room

VARIOUS types of motor driven erasers for drafting room practice have been tried out in the last few years, but they all have had some objectionable features, such as excessive wear of delicate parts due to eccentric loading of motor; breaking of the flexible cable; excessive noise from the motor, and the tendency of the disk eraser to cut through the drawing surface. Keeping these points in mind, C. F. Seymoure, of Swarthmore, Pa., has designed an electric eraser that apparently has overcome these objectionable features.



An Electric Eraser Which Will Clean Tracing Cloth Quickly and Not Tear It

The machine is driven by a variable speed motor, which derives its power through an electric light socket attachment. The shaft of the motor to which the eraser holder is attached will run at three different speeds which are controlled through a three position lever. The eraser holder is a hollowed, longitudinally segmented, cone frustum with the inside knurled and the segments brought in close contact with the eraser by a ring that slides over the lateral faces of the segments.

The formula for the erasers was adopted after much experimenting. It was found that if an abrasive was used the eraser would go through the drawing surface, and if no abrasive was used "glazing" resulted and the drawing was smeared. The abrasive used is powdered pumice stone, which gives satisfactory results.

The machine weighs less than two pounds and is simple to operate. The starting device and the variable speeds are obtained by a small movement with the thumb of the hand holding the instrument. The motor speeds are controlled by "stops" in the field wiring. This eliminates a rheostat and as a result no heat is generated by changing the speed. The shaft of the motor is held at an angle of 45 deg. with the plane of the table. The gyroscopic action of the motor armature tends to hold the machine at a constant angle. The weight of the motor is just sufficient to give the proper pressure on the drawing surface to eliminate a glazing of the eraser by the ink. It is only necessary to guide the machine with the fingers and it can be used any length of time in this position as the device is light in weight.

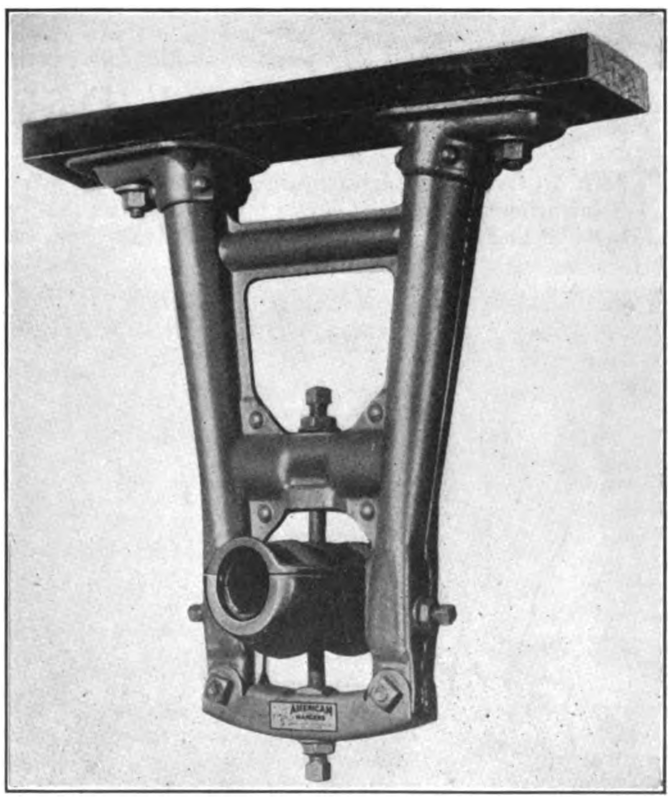
A Pressed Steel Shaft Hanger

A PRESSED steel shaft hanger with a high factor of safety and interchangeability of standard parts is being marketed by the American Pulley Company, Philadelphia, Pa.

The hanger is made entirely of pressed steel and is of the four point set screw type. It is of the parting variety which permits the quick removal of the shaft or bearings by means of a swing yoke. The main frame of the hanger is constructed of two stampings placed face to face, with in-turned flanges extending the entire length of the leg, which provide strength and rigidity. The cross brace is integral with the legs, making the entire frame rugged, serviceable and neat in appearance.

All machined parts are standard, which permits quick repairs to be made. The bolts, nuts and set screws are of standard dimensions and are accessible and convenient for replacement. The four bearing nuts on the set screws, which support the shaft load, are flushed with the inside edge of the short opening, which permits a minimum overhang. The foot of the hanger is of simple construction. It is made of heavy cold-drawn seamless steel, which provides ample strength to sustain the pressure of clamping bolts or lag screws. The attachment of the foot to the oval frame legs is through the seamless flange on the foot, and is held in place by heavy rivets carefully driven. The frame is smooth with rounded surfaces that eliminate dust pockets and projecting parts. All joints are accurately matched.

The hanger is made in regular drops of 7 in. to 24 in., and for all shaft sizes up to 3 in. A babbitted bearing box is provided, and the bearing is made accurately to size. The boxes are provided with capacious oil reservoirs.



A Two Part Shaft Hanger Which Permits the Quick Removal of the Shaft or Bearings

Automatic Chucking and Turning Machine

AN automatic chucking and turning machine designed to produce duplicate parts has been offered to the market by the Potter & Johnston Machine Company, Pawtucket, R. I. It is of unit construction, the headstock, turret slide, feed box and cross slide each being built as a unit.

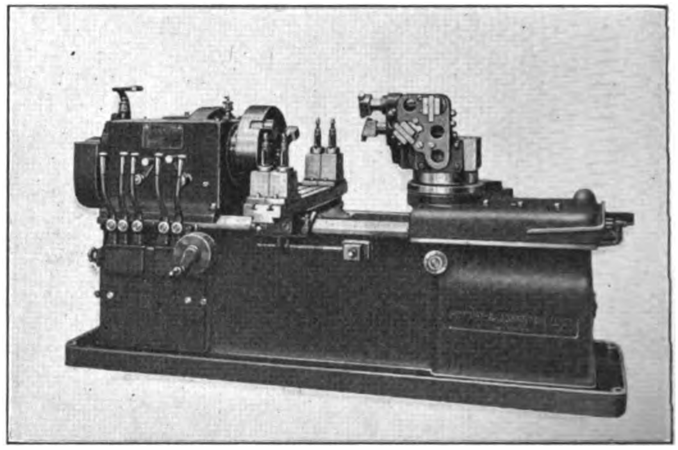
The base is of a heavy box section with wide ways. The guiding is all done on the front way. This is of a modified inverted V-section, which helps to insure accuracy in the alinement of the turret with the headstock.

The spindle, which is 5¾ in. in diameter, is made from a high carbon steel forging. The spindle gearing is made from heat treated steel. It runs in a bath of oil, and all the bearings are flood lubricated.

There are 16 changes of speed between 9 and 185 r. p. m., which are arranged in four sets of four automatic changes. Any group of the four changes may be obtained by the shifting of the hand levers on the front of the headstock, or by the speed change dogs. The feed gearing is driven from the spindle. There are 24 feeds in geometric progression from .007 to .250 in. per spindle revolution. They are in three groups; namely, coarse, medium and fine feeds. Each group has an independent set of hand change gears, which are located on the feed box, any one of which may be thrown in mesh by the feed dog, or by the hand lever. The feeds are independent of the high, constant speed for idle movements of the turret-slide while withdrawing, revolving and advancing the tools to the point of cutting.

The slide cam drum is located directly under the cross slide and the cam roll studs are located in the cross slide, thus making direct connection between the two. This enables the slide feed to be made the same as the turret feed. All thrust on the cross slide drum is taken up by thrust shoes directly in line with the point of contact of rolls and cam. Special cams may be easily and quickly attached without removing the cam drum.

The turret slide is of rugged construction and travels on wide ways, so designed that all wear will be even and will not affect the accuracy of the machine. It has 10 in. longitudinal adjustment by means of a hand crank and screw, and is securely clamped in any desired position by three



The Potter & Johnson Automatic Chucking and Turning Machine

bolts, besides being located by the adjusting screw. No adjustment is necessary for revolving the turret. The turret slide has 18 in. travel and may be equipped with either mechanical or air control.

According to the character of the work being handled, from five to fifteen cutting tools may be used in simultaneous operation, carried in the turret on the cross slide. Oil pump and piping may be furnished on machines handling material requiring a lubricant. The method of piloting all boring and turning tools insures extreme accuracy of all finished work coming from the automatics.

A Handy Device for Spotting Cars

THE Warren Steel Car Company, Warren, Pa., is manufacturing a car moving device for spotting cars that are to be loaded or unloaded, for moving cars from one track to another and for spragging cars on grades. It is known as the Congo car mover. It is said that a loaded car may be moved 8 inches with a single downward stroke of the handle, and there is sufficient leverage provided so that two loaded cars may be moved at one time without any great effort on the part of the operator.

A Single Downward Stroke of the Handle Will Move a Loaded Car 8 Inches

Three grips or clamps are provided to hold the car mover on greasy or icy rails, one grip at each side of the rail and one in the back. The main body, consisting of the operating lever and the operating lever shoe, are of cast steel. The side rail grips are of cast steel, casehardened, and the side die and rear die are made of tool steel. The other parts are made of rivet and spring steel and the handle is of maple.

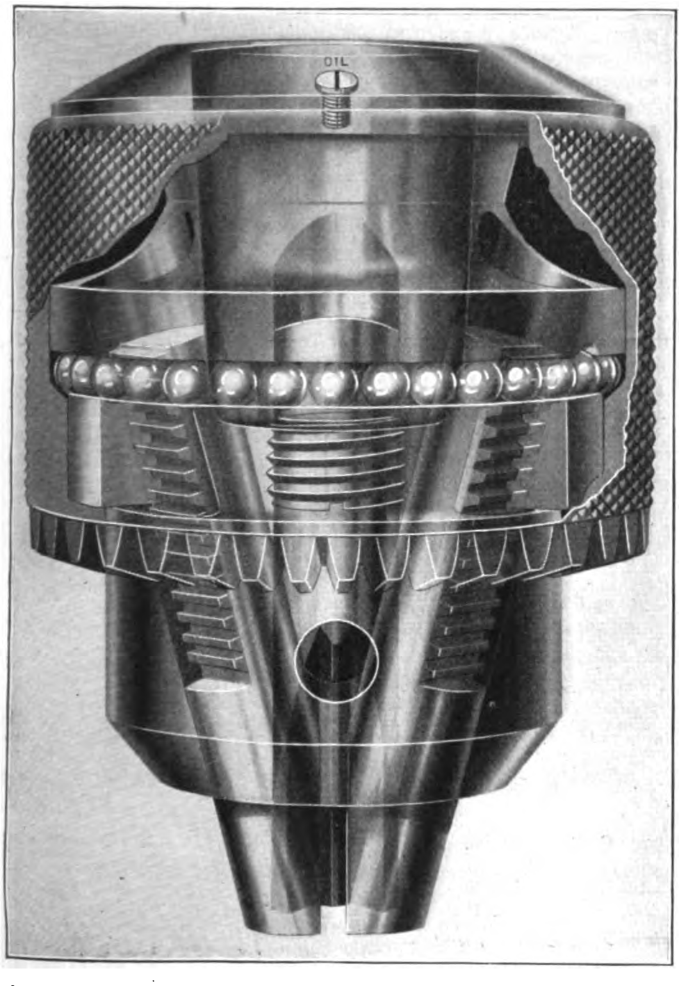
It is claimed that a car may be moved 40 ft. in a minute, or the equivalent of ½ mile an hour on a level grade. The device is so constructed that the operator can slide the car mover along the rail and keep the car in continuous motion. The operation starts with the workman standing in an upright position and then pushing the handle downward to within 8 or 10 in. of the rail. As the shoe has a sure grip on the rail, there is no danger of the operator's knuckles being struck or scarred against the rails. The wood is carefully selected so as to eliminate knots and unusual graining which would cause the handle to break.

Tooth Key and Sleeve Type Chuck

ACCURACY, ease of operation and durability are features that have been kept in mind in the design of the new chuck made by the Jacobs Manufacturing Company, Hartford, Conn. It is of the toothed key and sleeve type, and is essentially the same as other chucks manufactured by this company.

The body is made of steel of a special analysis, deeply casehardened. The taper hole, however, is left soft, fitting it for use on a hardened and ground arbor. This hole is accurately ground and is of the same dimensions as those of previous designs. A hole is drilled and tapped through the center of the body and fitted with a threaded plug which may be easily removed with a screw driver if it is desired to insert rods or other material through the chuck which is a much desired feature.

Ball bearings have been inserted between the nut and the body to reduce the friction, which not only reduces the pressure required to tighten the chuck, but makes possible a change in the construction of the jaws and nut so that fewer turns of the sleeve are necessary to open or close the jaws. The threads on the nut and jaws are machined at a 90-deg. pitch, which gives a more rapid action and greater strength.



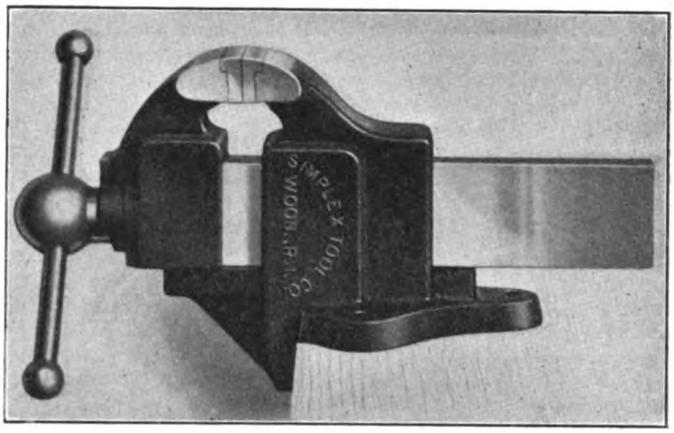
A Jacobs Chuck Containing Ball Bearings Between the Nut and the Body

An oil hole is inserted in the upper end of the chuck, making it possible to lubricate all of the working parts. One-half the pressure on the key in tightening the chuck will produce the same results as full pressure in chucks of previous design.

A Heavy Duty Vise

THE principal objects aimed at in the construction of a heavy duty vise are durability and strength. The Simplex vise, recently put on the market by the Simplex Tool Company, Woonsocket, R. I., embodies these principles.

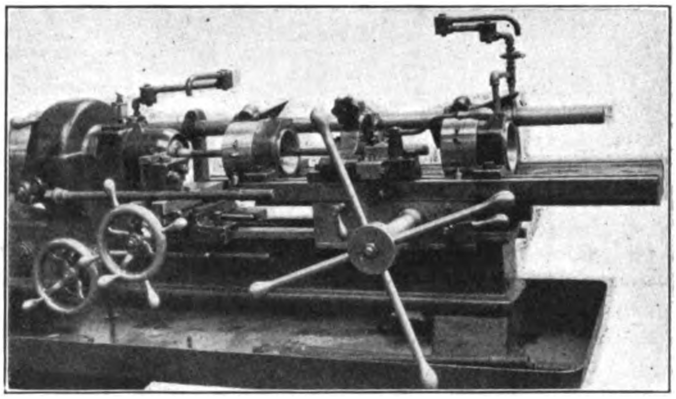
The particular feature of this device is that its slide is made entirely of steel, which adds greatly to its strength and durability. The body of the vise is cast of a special grade of crucible iron. The jaws are interchangeable and are made of steel, hardened and ground. The steel slide screw has a machine cut square thread and is retained in place by a cap in front of the sliding jaw. The nut is of ample length and is made of malleable iron.



Simplex Vice with Steel Slide

A Staybolt Threading Machine with New Attachments

THE Warner & Swasey Company, Cleveland, Ohio, has added to its staybolt machine a forming, facing and turning attachment. The machine itself was described in the March, 1922, issue of the *Railway Mechanical Engineer*. With its present equipment it will turn and face the end of the staybolt before the threading operation, which eliminates the chasers working on the rough scale.



Attachments for the Warner & Swasey Staybolt Machine Which Permit Turning and Facing Before the Threading Operation

The forming tool, which prepares the head for the thread cutting is held on the cross slide. The threading operations are performed by two die heads mounted on the turret slide and are so adjusted that the threads are in continuous lead. The die can be adjusted to cut a continuous thread. The cutting-off cutter is held in a swinging tool holder.

GENERAL NEWS

The condition of railroad equipment as reported by the Interstate Commerce Commission for April was: 6,290 locomotives inspected by the Bureau of Locomotive Inspection and 3,078 or 50.5 per cent found defective; and 399 were ordered out of service. The Bureau of Safety inspected 89,131 freight cars, of which 4.7 per cent were found defective, and 1,983 passenger cars, of which 1 per cent were found defective. During the month under review 20 cases involving 45 violations of the safety appliance acts were transmitted to various United States attorneys for prosecution.

The Chicago, Milwaukee & St. Paul is sending one of its largest electric locomotives on a three-months' tour of the states east of the Mississippi to allow the people of that part of the country to become familiar with the locomotives used in the Cascade Mountains. The engine will be exhibited in Detroit, Mich., Cleveland, O., New York, Philadelphia, Pa., Boston, Mass., and other New England cities. It will then be taken to Washington and Baltimore and from there will be sent back to Chicago. It will be accompanied by a coach fitted up with a lecture room and a car for the use of members of the party. Motion pictures of electrified trains moving through the mountains will be shown.

Wage Statistics for February

The number of employees reported by Class I railroads for February, 1924, was 1,753,289, an increase of 3,362 or 0.2 per cent over the number reported for the previous month, according to the Interstate Commerce Commission's monthly summary of wage statistics. Compared with the terms for the same month last year, the summary for February, 1924, shows a decrease of 1.7 per cent in the number of employees, and a decrease of 1.o per cent in the number of hours reported; but owing principally to an increase in the average hourly earnings, the total compensation shows an increase of 0.2 per cent.

Labor News

The United States Circuit Court of Appeals has affirmed a decision of the United States District Court for the Western division of the Western district of Missouri in which a man was held in contempt of court for violation of the injunction against strike violence, granted during the strike of shop crafts employees in 1922. The defendant, although not a striker, had participated in an assault on a St. Louis-San Francisco employee who had continued at work. The plea that the act had been committed in the Southern division of the Western district of Missouri and was therefore outside the jurisdiction of the court of the Western division was over-ruled by the Court of Appeals.

Labor Board Decisions

Jurisdiction of Labor Board.—The Labor Board, in the dispute between the Federated Shop Crafts and the Great Northern, has rendered a decision that it is without jurisdiction in disputes between a railway and men not in its employ. This case related to a memorandum agreed upon by the Great Northern and a representative of its striking shopmen which set forth conditions upon which they would be returned to their former positions. The Labor Board recognized the fact that the strikers were referred to in the memorandum not as employees but as "former employees" and "applicants for employment." The application of the Federated Shop Crafts for the reinstatement of one of the strikers was denied by the Labor Board.—Decision No. 2302.

Six New Storage Battery Cars on C. N. R.

The Canadian National will commence to operate within a few days six new storage battery cars. Three of these cars will run from Montreal to points nearby and will add considerably to the suburban service at present being given by the system.

These cars are 53 ft. long, about 9 ft. wide, 12 ft. high, have vestibule ends and can be operated from either end. The interior has a mahogany finish and is equipped with canvas-lined rattan seats. There is seating accommodation in each car for fifty passengers, in addition to baggage space.

The Steel Car Bill

A sub-committee of the Senate committee on interstate commerce has made a favorable report on the bill S.863, "for the

LOCOMOTIVE REPAIR SITUATION—FORMER METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. held for repairs req. over 24 hours	Per cent	No. held for repairs req. less 24 hours	Per cent	Total held for repairs	Per cent
January 1	64,453	48,905	576	13,587	21.1	1,962	3.0	15,549	24.[illegible]
April 1	64,559	50,107	914	12,801	19.8	1,651	2.6	14,452	22.4
July 1	63,906	52,456	2,181	10,326	16.2	1,124	1.8	11,450	1[illegible]
October 1	63,982	54,159	2,620	8,789	13.7	1,034	1.6	9,823	15.3
1924									
January 1	64,406	54,031	5,061	9,395	14.6	980	1.5	10,375	16.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
May 1	64,330	52,890	6,079	6,105	9.5	5,335	8.3	11,440	17.8

FREIGHT CAR REPAIR SITUATION

Date 1923	No. freight cars on line	Cars Awaiting Repairs: Heavy	Light	Total	Per cent of cars awaiting repairs	Month 1923	Cars Repaired: Heavy	Light	Total
January 1	2,264,593	164,041	51,970	216,011	9.5				
April 1	2,296,997	154,302	52,010	206,312	9.0				
July 1	2,260,532	146,299	44,112	190,411	8.4	June	121,077	2,451,758	2,572,8[illegible]
October 1	2,270,840	118,563	32,769	151,332	6.7	September	114,064	2,335,161	2,449,2[illegible]
November 1	2,263,099	116,084	34,540	150,624	6.6	October	117,254	2,444,118	2,561,37[illegible]
December 1	2,270,405	116,697	38,929	155,626	6.8	November	104,761	2,214,617	2,319,37[illegible]
1924									
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,03[illegible]
						1924			
February 1	2,269,230	115,831	45,738	161,569	7.1	January	76,704	2,083,583	2,160,2[illegible]
March 1	2,262,254	119,505	49,277	168,782	7.5	February	70,056	2,134,781	2,204,8[illegible]
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,5[illegible]
May 1	2,271,638	131,609	47,666	179,275	7.9	April	75,352	2,074,629	2,149,98[illegible]

protection of persons employed on railway express cars, railway baggage cars and railway express-baggage cars," with certain amendments including a change in the effective date to July 1, 1927. After that date the bill provides that all such cars and their parts shall be of such construction, style and strength and furnished in such manner as shall be required by the Interstate Commerce Commission, and that the commission shall not allow to be used any such car not constructed of steel or steel underframe or of equally indestructible material, except that it may grant relief from this requirement for short trains or trains operated for short distances at a low rate of speed and the requirements will not apply when the cars are locked or sealed and not carrying persons. After July 1, 1927, such cars accepted for service or contracted for would be required to be of steel and in accordance with regulations made by the commission. The amendments are intended to meet some of the objections made by the railroads on the ground of expense.

Milk Used in Locomotive Instead of Coal

The Chicago, Rock Island & Pacific, on April 24, ran a special train of five cars carrying 200 children, from La Salle street station to 91st street and return, a distance of 20 miles, using lumps of powdered milk as fuel instead of coal. The run was made at the request of Dr. Herman N. Budesen, health commissioner of Chicago, who wished to emphasize and advertise his axiom, "Milk is to the human body as fuel is to the locomotive," which he is using in his campaign to educate children regarding the value of milk. The locomotive was first fired with coal but fire was maintained throughout the run with briquets of dried milk made especially for the occasion. The heat given off per pound of milk is stated to be 10,000 B. t. u., while that of coal is 11,000. The weight of milk consumed during the run was greater than the amount of coal that is used on the same run ordinarily.

Court News

BOILER SAFETY ACT—HANDHOLDS MUST BE FASTENED WITH BOLTS OR RIVETS.—In an action for injury to a switchman it appeared that while stepping from the footboard of a tender while the engine was in motion his glove caught in a cotter pin used to fasten the handhold and he was thrown down and dragged. The Circuit Court of Appeals, Fifth Circuit, holds that sections 2 and 5 of the Boiler Safety Act are extended by the amendment of 1915 to tenders, that the Interstate Commerce Commission's rule requiring handholds on switching locomotives to be securely fastened with bolts or rivets is valid, and that the substitution of a cotter pin was such a failure to comply with the act as to render the defendant liable, regardless of its negligence.—F. W. & D. C. v. Jones, 294 Fed. 858.

PASSENGER CARS ORDERED, INSTALLED AND RETIRED

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
January-March	792	679	54,370
April-June	513	555	54,328
July-September	553	531	54,349
October-December	861	948	54,262
Full year, 1923	2,719	2,713	......
1924			
January-March	699	431	54,519

Figures from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division and are not therefore strictly comparable with figures given in first two columns of table.

LOCOMOTIVES INSTALLED AND RETIRED

Month 1923	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
Sept. ...	384	22,342,517	260	7,191,302	64,720	2,506,469,051
Oct. ...	408	21,665,487	301	7,935,709	64,827	2,520,200,846
Nov. ...	333	19,054,713	282	7,741,395	64,879	2,532,085,380
Dec. ...	333	18,260,423	316	8,738,378	64,896	2,541,607,425
1924						
Jan. ...	271	15,228,895	178	4,447,721	64,989	2,552,694,953
Feb. ...	214	11,296,088	175	4,906,435	65,029	2,559,519,253
March ..	176	10,457,064	181	6,033,173	64,911	2,560,076,766

Figures prepared by Car Service Division, A. R. A., published prior to October in reports relative to progress, made on A. R. A. transportation program, and more recently in greater detail given in form C. S. 56 A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

MEETINGS AND CONVENTIONS

New Program Arrangement for the A.S.T.M. Meeting

As previously announced in these columns, the twenty-seventh annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall, Atlantic City, N. J., on June 24 to 27. A departure is being made this year in the arrangement of the program by which parallel sessions will be held practically throughout the meeting with no afternoon sessions after the first day. Registration starts on Monday, June 23, and that day and Tuesday morning have been reserved for committee meetings. The general arrangement of the program is as follows:

Tuesday, afternoon, symposium on corrosion resistant, heat resistant and electrical resistance alloys; and coal, timber, rubber and textiles; evening, continuation of symposium; and paints, petroleum products, insulating materials and thermometers. Wednesday, morning, non-ferrous metals, corrosion and metallography; and lime, gypsum and ceramics; evening, president's address and administrative committee reports. Thursday, morning, steel; and road and paving materials and waterproofing; evening, methods of testing and nomenclature. Friday, morning, magnetic analysis and fatigue of metals; and cement and concrete; evening, wrought and cast iron and cast iron pipe; and concrete and reinforced concrete.

New Officers for Canadian Railway Club

C. E. Brooks, chief of motive power of the Canadian National, was elected president of the Canadian Railway Club at the twenty-second annual meeting and smoker of the club at the Windsor Hotel, Montreal, on May 13. In addition to the reading of the annual reports and the election of officers, a varied program of entertainment was provided by members from companies performing at local theatres.

Other officers elected were as follows: First vice-president, J. A. Shaw, electrical engineer, C. P. R.; second vice-president, E. R. Battley, superintendent of motive power, Eastern lines, C. N. R.; executive committee, J. Burns, works manager, C. P. R. Angus shops; W. F. Connal, mechanical engineer, C. N. R.; J. E. Muir, assistant works manager, C. P. R. Angus shops; T. M. Hyman, superintendent car shops, C. N. R.; G. Whiteley, assistant superintendent of motive power, C. P. R., and W. A. Booth, director of safety and first aid, C. N. R.; audit committee, J. W. Fontaine, chief clerk to auditor of stores and mechanical accounts, C. P. R.; A. McDonald, assistant to superintendent of motive power, C. N. R., and E. G. Jackson, president and general manager of the International Equipment Company; treasurer, P. P. Reynolds, chief clerk to chief of motive power and rolling stock, C. P. R.; secretary, C. R. Crook, head timekeeper, motive power, Dewer shops, C. N. R.

Mechanical Division Program

Division V—Mechanical, American Railway Association, will hold its annual meeting at Atlantic City, N. J., from June 11 to 18, inclusive. The sessions will be held in the Greek Temple on the Million Dollar Pier and will extend from 9:30 a. m. to 12:30 p. m., daylight saving time, except on Saturday, June 14, which will be available for the examination of exhibits. No sessions will, of course, be held on Sunday, June 15.

On Wednesday, June 11, in addition to routine matters, there will be the annual address by the chairman of the Division, John Purcell, assistant to the vice-president of the Atchison, Topeka & Santa Fe; an address by President R. H. Aishton of the American Railway Association; and reports of the General Committee, the Committee on Nominations and the Committee on Locomotive Design and Construction.

On Thursday, June 12, there will be a discussion of the report on Shop and Engine Terminals and the following individual papers: The Modern Locomotive, by W. H. Winterrowd, assistant to president, Lima Locomotive Works; the Lehigh Valley Three-Cylinder Locomotive No. 5,000, by J. G. Blunt, American Locomotive Company; the Relation of Track Stresses to Locomotive Design, by C. T. Ripley, chief mechanical engineer, A. T. & S. F.

On Friday, June 13, the reports on Locomotive and Car Lighting and Electric Rolling Stock will be discussed. An individual paper on Development of the Electric Locomotive, by F. H. Shepard, director of heavy traction, Westinghouse Electric & Manufacturing Company, will also be presented.

On Monday, June 16, Frank McManamy, of the Interstate Com-

merce Commission, will make an address and the following individual papers will be presented: Governmental Relations to Transportation, by W. R. Cole, president, Nashville, Chattanooga & St. Louis; Proper Training of Shop Supervisory Forces, by L. W. Baldwin, president, Missouri Pacific. There will also be discussions of the reports on Specifications and Tests for Materials and on Car Construction and the annual election of officers.

On Tuesday, June 17, there will be a discussion of the following reports: Prices for Labor and Material, Arbitration, Tank Cars, Loading Rules and Safety Appliances.

On Wednesday, June 18, the last day of the convention, the following reports will be discussed: Autogenous and Electric Welding, Brakes and Brake Equipment, and Wheels.

Some time during the sessions of the convention an address will be made by W. R. Scott, president of the Southern Pacific, Texas and Louisiana Lines.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILROAD ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 24-27, Chalfonte-Haddon Hall, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Semi-annual meeting June 12, Hotel Dennis, Atlantic City, N. J. Annual meeting October 20-24, Hotel La Salle, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 9-14, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Vanadium Alloys Steel Company, Latrobe, Pa., has removed its New York office to 270 Madison avenue.

The Equipment Specialties Company has moved its Chicago office to room 936, 310 South Michigan avenue.

The Union Asbestos & Rubber Company has moved its Chicago office to room 936, 310 South Michigan avenue.

The Ohio Injector Company is planning the construction of a three-story addition to its factory at Wadsworth, Ohio.

The Sullivan Machinery Company, Chicago, has moved its Pittsburgh office to Rooms 517-520, Farmers Bank building.

The Hutchins Car Roofing Company has moved its Chicago offices to the Straus building, 310 South Michigan avenue.

L. A. Marshall, service manager of the Industrial Works, Bay City, Mich., has been appointed sales engineer, with headquarters at Chicago.

The Locomotive Stoker Company has moved its New York offices from 50 Church street to the new Westinghouse building 150 Broadway.

The Chicago district sales office and warehouse of the Garlock Packing Company, Palmyra, N. Y., has been removed to 600 West Jackson boulevard.

The Simmons-Boardman Publishing Company has opened an office at 74 New Montgomery street, San Francisco, Cal. Homer Beach will be in charge.

The Austin Company, Cleveland, Ohio, has removed its Chicago office from the Continental & Commercial Bank building to suite 1300 Burnham building, 160 North La Salle street.

Joseph T. Ryerson & Son, Inc., Chicago, has taken over the exclusive distribution of Lewis special staybolt iron manufactured by the Penn Iron & Steel Company, Creighton, Pa.

W. A. Lake

William A. Lake, who has been connected with the Pantasote Company, New York, for the past 15 years, has been appointed sales manager of its railroad and marine department, for the disposition of all Pantasote and Agasote products in those fields. Mr. Lake entered service of the Pantasote Company in its sales department on April 1, 1909, and was given charge of the railroad and the entire marine fields, for the territory composed of the southern, the middle states, a few of the western states and the Island of Cuba. In the marine field Mr. Lake has built up a very large business for the Pantasote Company.

The Pressed Steel Car Company and the Western Steel Car & Foundry Company have moved their Chicago offices to 604 Corn Exchange Bank Building, 134 S. LaSalle street.

Harvey S. Patterson, manager of the railroad department of the Walworth Manufacturing Company, Boston, Mass., died on April 6 at the Norfolk county hospital, Mass., at the age of 38.

Fred R. Cooper, general sales manager of the Gold Car Heating & Lighting Company, Brooklyn, N. Y., died at his home, Northbrook courts, Washington, D. C., on May 10, after a short illness.

D. S. Wood, district sales manager of the Niles-Bement-Pond Company, with headquarters at Philadelphia, Pa., has been transferred to Chicago, succeeding Samuel G. Eastman who has been granted a leave of absence.

C. H. Smith, assistant secretary of the Westinghouse Air Brake Company, and director of clerical operations of all of that company's interests, has, in addition, been elected vice-president of the Westinghouse Union Battery Company, Swissvale, Pa.

L. D. Albin, general sales manager of the Ingersoll-Rand Company, New York City, has been elected vice-president in charge of European sales, and D. C. Keefe, assistant general sales manager, has been appointed general sales manager to succeed Mr. Albin.

The Edwards Railway Motor Car Company, Sanford, S. C., has decided to increase its capital stock $500,000 and to begin work immediately erecting additional buildings, and providing necessary machinery to bring the output of the plant up to 30 cars a month.

L. S. Carroll, general purchasing agent of the American Locomotive Company, New York, has been elected vice-president in charge of purchases. Mr. Carroll entered the service of the Chicago & North Western about 1886 as a helper at a station in Dakota. He learned telegraphy and later served as operator and station agent. He was then transferred to the accounting department in Chicago where he served consecutively as travelling auditor and general travelling auditor, until his appointment in 1901 as purchasing agent. He subsequently became general purchasing agent for both the Chicago & North Western and the Chicago, St. Paul, Minneapolis & Omaha railroads. During government operation of the railroads Mr. Carroll was chairman of the Northwestern Regional Purchasing Committee and on the return of the railroads to their owners Mr. Carroll went on March 1, 1920, to the American Locomotive Company as general purchasing agent, which position he held until his recent appointment as vice-president in charge of purchases of the same company.

L. S. Carroll

David Maxwell, formerly district manager of the Cleveland branch of the Williams Tool Corporation, Erie, Pa., has been appointed district manager of the Chicago branch, with headquarters at 549 West Washington boulevard, Chicago, succeeding Blake D. Hay, resigned.

E. W. Allen, formerly engineer and assistant manager of the central district of the General Electric Company, with headquarters at Chicago, has been appointed manager of the engineering department of that company and A. F. Riggs has been appointed district engineer to succeed Mr. Allen. E. W. Allen was born in Buchanan, Va., on November 8, 1880, and was graduated from the Virginia Polytechnic Institute in 1900 with a B. S. degree in electrical engineering. He first entered the employ of the General Electric Company in January, 1901, in the test department at Schenectady, and in December of the following year he was assigned to the lighting engineering department, where he remained until September 30, 1911, when he was appointed engineer of the Chicago district. On September 1, 1913, he was appointed assistant district manager in addition to his duties as district engineer. Early in 1917 he entered the military service and served two years. He returned to the company in April, 1919.

E. A. Lundy, of the business staff of the Simmons-Boardman Publishing Company, publishers of the *Railway Mechanical Engineer*, and business manager of Railway Signaling and the Railway Electrical Engineer, two of this company's publications, has resigned to organize the E. A. Lundy Company, with headquarters in the Union Trust Building, Pittsburgh, Pa., to take over the sales and service of a number of companies in the railway field. Preston Parish, formerly with the Line Material Company, South Milwaukee, Wis., is manager of the line materials division, and Earl M. Allen, formerly with the Matthews Engineering Company, Sandusky, Ohio, is signal engineer of the new company.

TRADE PUBLICATIONS

PUNCHES AND SHEARS.—Bulletin No. 28, superseding Bulletin No. 8 and briefly pointing out a few of the prominent features of Morgan punches and shears, has recently been issued by the Morgan Engineering Company, Alliance, Ohio.

SPRINGS.—Catalogue No. 3, descriptive of coil and elliptic springs for steam and electric railway service, has recently been issued by the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa.

BALL JOINTS.—Bulletin No. 801 descriptive of improved Franklin ball joints, for which no specially molded packing gaskets are required, has been issued by the Franklin Railway Supply Company, New York.

PIPE CLAMPS.—Bulletin No. 905, descriptive of multiple pipe clamps designed with a view of laying out the piping of a locomotive in the drawing room and showing the location of each clamp, has been published by the Franklin Railway Supply Company, New York.

DRY VACUUM PUMPS.—Bulletin No. 78-B, briefly describing steam driven and belt-driven, single-cylinder vacuum pumps, built in capacities ranging from 100 to 1,600 cu. ft. displacement per minute, has been issued by the Sullivan Machinery Company, Chicago, Ill.

AIR COMPRESSORS.—Angle-compound power-driven air compressors of the belted and direct connected classes, and belt-driven air compressors of the single and two-stage types, are illustrated and described in Bulletins Nos. 77-H and 77-K, which have recently been issued by the Sullivan Machinery Company, Chicago, Ill.

ELECTRICAL HISTORY.—"Forty Years Ago" is the title of a 21-page booklet illustrated with pen and ink sketches, published by the Westinghouse Electric & Manufacturing Company. The booklet describes briefly electrical progress which has been made during the past 40 years and the relation of the Westinghouse Company to this progress.

CROSS-DRUM BOILERS.—Bulletin No. 53, fully descriptive of the Heine M and MC types of cross-drum boilers, has recently been issued by the Heine Boiler Company, St. Louis, Mo. While cross-section views show only the different furnace arrangements for the burning of coal, the boilers may be adapted to the use of waste heat, powdered fuel, oil, gas, or any other fuel.

FLUE WELDERS.—Bulletin No. FW, describing railroad flue welders for safe ending and salvaging boiler tubes and superheater flues, scrap salvaging, etc., and showing shop layout, comparison of costs, various electric methods of welding tubes and superheater flues, current characteristics, etc., has been prepared for distribution by the Thomson Electric Welding Company, Lynn, Mass.

STARRETT TOOLS.—A 352-page, illustrated catalogue, descriptive of fine mechanical tools, hacksaws, steel tapes, etc., has been issued by the L. S. Starrett Company, Athol, Mass. Sixty-two new tools, including angle gages, hold downs, pocket micrometer cases, tool bench gages, rolling mill gages, and a number of other tools which have been added to the Starrett line since the publication of the last catalogue, are among the 2,200 tools described.

TRAMRAIL SYSTEM.—A general description of the Cleveland electric tramrail system of hoisting and conveying loads weighing 4,000 lb. or less, is given in Catalogue No. 3 recently issued by the Cleveland Crane & Engineering Company, Wickliffe, Ohio. This system is a combination of standardized rail, fittings and carriers, which have been developed to meet the demand for an inexpensive system for use in warehouses, foundries, machine shops, etc.

SMALL WOOD PRESERVING PLANT.—A small 4-page, illustrated booklet has recently been issued by Grant B. Shipley, engineer, Pittsburgh, Pa., descriptive of a small wood preserving plant which has been developed primarily for small users of timber. This type of plant is built in several different sizes and the text describes the different capacities, the advantages, the construction, the type of treatment and the method of operation. The arrangement, operation, etc., is similar to that used in the large plants of the Century Wood Preserving Company.

PERSONAL MENTION

General

Howard Stillman, mechanical engineer and engineer of tests of the Southern Pacific at San Francisco, Cal., has retired.

F. E. Russell, assistant mechanical engineer of the Southern Pacific, at San Francisco, Cal., has been promoted to mechanical engineer, with the same headquarters, succeeding H. Stillman.

R. M. Brown, engineer of motive power of the New York Central, with headquarters at New York, has been appointed assistant superintendent of motive power, with the same headquarters.

The headquarters of G. B. Frabel, assistant general superintendent of motive power of the Southwestern region of the Pennsylvania, have been removed from St. Louis, Mo., to Columbus, Ohio.

D. Wood, assistant mechanical engineer and assistant engineer of tests, of the Southern Pacific, has been promoted to engineer of tests, with headquarters at San Francisco, Cal., also succeeding H. Stillman.

Master Mechanics and Road Foremen

C. G. Goff, master mechanic of the Southern at Spencer, N. C., has been transferred to South Richmond, Va.

J. S. Breyer, has been appointed master mechanic of the Southern at Charleston, succeeding J. L. Camtwell.

C. G. Henderson has been appointed master mechanic of the Southern, with headquarters at Charleston, S. C.

T. J. Clayton, whose appointment as master mechanic of the Texarkana & Fort Smith, with headquarters at Port Arthur, Tex., was announced in the May issue of the *Railway Mechanical Engineer*, was born on March 28, 1870, at Bethalto, Ill. Mr. Clayton is a graduate of the Moberly, Mo., high school and of the Lake Forest Academy. In September, 1888, he entered the employ of Wabash as a call boy at Moberly. He then successively served as machinist apprentice, locomotive fireman and engineer, resigning in 1894. In 1895, he was appointed locomotive fireman of the Cleveland, Cincinnati, Chicago & St. Louis at Mattoon, Ill.; in 1896, locomotive fireman of the Kansas City Southern at Pittsburgh, Kans.; in 1898, locomotive engineer; in 1902, traveling air brake inspector; in 1905, district foreman at Mena, Ark.; in 1912 district foreman at Dequeen, Ark.; in 1914, district foreman of the Texarkana & Ft. Smith at Port Arthur, Tex.; in 1916, district foreman of the Kansas City Southern at Dequeen; in 1918, master mechanic of the Texarkana & Ft. Smith at Texarkana; and in 1923, general foreman at Port Arthur.

T. J. Clayton

Shop and Enginehouse

F. J. Myers has been appointed blacksmith foreman of the Atchison, Topeka & Santa Fe, with headquarters at Argentine, Kan.

G. J. Mehl, gang foreman of the back shop of the Oregon Short Line at Pocatello, Idaho, has been appointed day roundhouse foreman, with headquarters at Glenns Ferry, Idaho, succeeding Harry Todd resigned.

E. B. Farrell, machinist, has been promoted to assistant enginehouse foreman of the Baltimore & Ohio, with headquarters at New Castle Junction, Pa.

J. J. Wagley has been appointed assistant roundhouse foreman of the Baltimore & Ohio, with headquarters at Keyser, W. Va., succeeding W. A. Earnest, resigned.

Harry M. Wilson, roundhouse foreman of the Atchison, Topeka & Santa Fe at Raton, N. M., has been promoted to general foreman, with headquarters at Wellington, Kans.

E. F. Frederiksen, assistant school and shop instructor of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., has been promoted to assistant night roundhouse foreman, with headquarters at Raton, N. M.

Purchasing and Stores

T. E. Britt has been appointed storekeeper of the Baltimore & Ohio, with headquarters at Washington, Ind.

H. E. Litchfield has been appointed storekeeper of the Baltimore & Ohio, with headquarters at Baltimore, Md., succeeding T. E. Britt.

Frank Justice has been appointed assistant storekeeper of the Boston & Maine, with headquarters at Mystic Wharf, Mass., succeeding David G. Akehurst, deceased.

W. J. Kelleher has been appointed purchasing agent of the Alabama & Vicksburg, with headquarters at New Orleans, La., succeeding T. H. Ryan, resigned to accept service with another company.

H. E. Anderson has been appointed assistant purchasing agent of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn., succeeding William Nelson who has resigned to engage in other business.

Louis Lavoie, whose appointment as general purchasing agent of the Canadian National, with headquarters at Montreal, was announced in the May issue of the *Railway Mechanical Engineer* was born at Rimouski, Que., on June 22, 1879, and in 1894 entered the service of the Intercolonial Railway at Moncton, N. B., as a junior clerk. He was employed in various clerical capacities from that time until 1905 when he became assistant to the general manager, operating branch. In 1909 he was appointed a purchasing agent for the Canadian Government Railways at Ottawa and in March, 1910, became purchasing agent for the Department of Railways and Canals (C. G. R. Lines and Dominion canals), with headquarters at Ottawa. On January 1, 1919, he was appointed assistant general purchasing agent of the Canadian National at Toronto and on December 1, 1920, was promoted to general purchasing agent. With the formation of the present Canadian National Railways, Mr. Lavoie was appointed purchasing agent at Toronto and held that position until his recent promotion.

Car Department

C. T. Robison, car foreman of the Baltimore & Ohio at Garrett, Ind., has been transferred to New Castle Junction, Pa.

F. E. Cheshire, car foreman of the Baltimore & Ohio at Sandusky, Ohio, has been transferred to South Chicago, Ill.

Robert B. Hagerty has been promoted to car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Gallup, N. M.

H. E. Negley has been appointed car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan. succeeding B. F. Ecord.

A. W. Fischer, assistant car foreman of the Baltimore & Ohio at Sandusky, Ohio, has been promoted to car foreman, succeeding F. E. Cheshire, promoted.

O. L. Hott, car foreman of the Baltimore & Ohio at New Castle Junction, Pa., has been appointed general car foreman, with headquarters at Garrett, Ind.

R. A. Kleist, car foreman of the Baltimore & Ohio at South Chicago, Ill., has been promoted to general car foreman, with headquarters at Lorain, Ohio.

B. F. Ecord, car foreman of the Atchison, Topeka & Santa Fe at Chanute, Kan., has been appointed acting general car foreman, succeeding L. H. Klein, retired.

Railway Mechanical Engineer

Vol. 98 July, 1924 No. 7

The hot box competition, which was announced in the January and February issues of the *Railway Mechanical Engineer* and closed on March 1, aroused a wide interest among our subscribers in the car department. A total of twenty-six papers were submitted, many of which contain some excellent suggestions for the prevention of hot box epidemics, the sudden development of which frequently makes life miserable for the car foreman. The first prize has been awarded to a car foreman writing under the name of M. S. Roberts. The second prize has been awarded to Oscar Skegsberg, an assistant car foreman of Detroit, Mich. Several of the other papers were close contenders for the prizes and contain constructive material which will make them valuable contributions for the attention of our readers when they are published. The paper winning the first prize will appear in next month's issue.

Winners in Hot Box Competition

While not unanimous, the opinion of by far the great majority of railroad mechanical men regarding inspection pits at engine terminals is favorable. Particularly in the case of busy terminals where many locomotives are conditioned for service and turned daily, the general experience has been that locomotive inspection pits on incoming tracks facilitate the immediate location of defects and enable those defects to be corrected and the locomotives returned to service more promptly. Many present terminals, where a sufficient number of locomotives are being handled, could doubtless be improved by the provision of inspection pits, together with a proper arrangement for the prompt transmission of inspectors' reports to the enginehouse foremen and supervisors. Locomotive inspection pits are usually of concrete construction, well drained and deep enough so that inspectors will have ample room to inspect the driving wheels, axles, boxes, binders, spring rigging, brake rigging, etc., without stooping in an awkward position which cannot be maintained. Particular attention should be given to the lighting arrangement so that on the darkest nights the pit lights will thoroughly illuminate the under parts of locomotives to such an extent that inspectors can examine them with practically the same degree of care as in the daytime. The importance of this feature in enabling slight defects to be noticed and corrected before trouble develops can hardly be over-emphasized. Another important feature of inspection pits is the possibility of making minor repairs on the spot as soon as they are discovered. This obviates entering these minor repairs on the inspector's report, saves the time of enginehouse forces which would otherwise be required to look up the locomotive and hunt around for the defect, and in general, greatly speeds the movement of locomotives through the terminal. One railroad which has recently taken advantage of this method of expediting engine terminal work is the New York, New Haven & Hartford. This road has within the past few months installed two locomotive inspection pits at its two Boston enginehouses, located at Dover street and Southampton street, respectively. Highly satisfactory results are said to have followed the installation of these pits, indicating that the expense involved in their construction was more than justified.

Locomotive Inspection Pits Prove Value

The volume of sand handled at a large engine terminal warrants a careful study to determine the most economical way to prepare it for service. The two means most commonly used to dry sand are the coal stove and steam coils. The coal stove has been used for years and as the amount of sand used has increased with the size and number of locomotives handled, it has been found to be uneconomical and a dangerous fire hazard. The coal stoves have to be kept in operation twenty-four hours in order to maintain the supply. This materially increases the cost of drying sand on account of the continuous use of coal as a fuel and the labor required to handle the sand. The bins in which the sand is dried and stored are usually of wooden construction. These have been the source of serious fires which have resulted in greatly hampering the dispatching of power. A further delay results when the stoves burn out and have to be renewed. To overcome this expensive and dangerous method of drying sand a few railroads have installed at their important terminals large vats containing a series of steam pipe coils. The steam used to dry the sand is obtained from the exhaust steam line of the power plant. It has been found that for enginehouses dispatching on the average of one hundred locomotives per twenty-hour hours, that sufficient sand can be dried and stored by one man in eight hours to supply the terminal for the remaining sixteen hours. The fire hazard is entirely eliminated and maintenance cost is reduced to a minimum.

Drying Sand by Steam

Jigs and fixtures determine the output of the shop, and the utilization and the type selected is of primary importance. If a railroad invests a large sum of money in new machine tools and does not have suitable jigs and fixtures to hold the work the money expended for the tools is practically wasted. The development and utilization of jigs and fixtures is usually left to the initiative of the man in the shop or the foreman. Many jigs are developed under pressure such as in a case where a machine is holding up the work of a department to such an extent that it affects the output of the whole shop. This practice does not always get the best results on account of the short time allowed to give the job and machine sufficient study. This system also tends to bring haphazard results in efficient workmanship, as well as to produce a variety of fixtures instead of standard types. Take for ex-

Do Your Jigs Save You Money?

ample, the jigs used for holding shoes and wedges on the table of a planing machine. If a census were taken of the different type of jigs now in use in the railroad shops throughout the country the total would startle the most conservative shop superintendent or master mechanic. Out of this number there must be one jig that is better than the rest. The only limiting condition in choosing the proper jig for this work would be whether the planer was being used entirely for shoes and wedges or for other work as well. It is not difficult to see the need of a careful study as to the type of jigs and fixtures that are being used in the shops. It is important that jigs be standardized and installed under proper and adequate supervision; a variety will not bring the most efficient and economical results. Every maintenance of equipment department should take the necessary steps toward the systematic study and development of the jigs and fixtures in all its shops.

The Vitality of the Steam Locomotive

One of the most striking characteristics of the steam locomotives is its vitality after a century of marvelous developments in the field of transportation which has produced the electric transmission of power, the automobile and the aeroplane. Circumscribed by limits of clearance, space and the severest kind of operating conditions, its development has never failed to meet the constant demands for greater capacity and greater efficiency. Many times it has appeared that the practical limit of development had been reached, but prophesies to this effect have always been followed by an improvement in an unexpected direction, which immediately showed their fallacy. Indeed, as the minds of engineers have become adjusted to the thought that the future possibilities were limitless because of the repeated demonstrations of the last two decades, there has even been an acceleration in the rate at which future possibilities were opened up. There probably have never been at one time more avenues of development opening up for the immediate future than are now evident. There is the 50 per cent cut-off principle which has thoroughly demonstrated its practicability and value under certain conditions as a means of increasing the economy and the adhesion capacity of the locomotive. There is the three-cylinder design, the possibilities of which have not yet been fully exploited, for increasing the adhesion capacity, the economy and the versatility of the locomotives of a single design for a wide range of service conditions. There is the possibility of using higher steam pressures through a departure from the conventional design of the locomotive boiler. There are the advantages of compounding, well established with relation to saturated steam and still attainable, though probably in a lesser degree, with superheated steam. All these developments are under active consideration at the present time. What is of most significance in the present situation is the open-minded attitude with which all of these developments are being watched by railroad men of all ranks. No better evidence than this is needed to prove the youth and vitality of the steam locomotive.

The "Waste in Car Repairs" Competition

A competition on the elimination of waste at outlying car repair points was announced in the March and April issues of the *Railway Mechanical Engineer*. Prizes of $50 and $35 were offered for the best and second best article written on this important subject. Seven papers were submitted which contained a number of constructive suggestions as to how wasteful conditions at outlying car repair points could be remedied. Considering the unsatisfactory conditions that are to be found at small car repair points on many of our railroads, one would naturally expect a greater interest to be shown in this subject, especially from the car men who work at such points. From the standpoint of supply, the stores department usually handles its part of the work quite efficiently. However, in many instances, adequate facilities are not available to take care of the material and tools used. Tools and repair parts cost money. Perhaps a road with only one or two such points does not find the waste to be a serious enough problem, in comparison with others, to give it consideration. From the standpoint of economy and efficient workmanship a careful study of this particular phase of car department work would be worth while. The paper, by W. A. Perkin, car inspector, Union Pacific System, Salt Lake City, Utah, to which the first prize has been awarded, emphasizes the necessity of providing proper storing facilities. The importance of frequent inspection trips was brought out in the paper by Arthur Schafnitt, car department foreman, St. Louis-San Francisco, Birmingham, Ala., which won second prize. The need of standard buildings and a uniform system of handling tools and material was mentioned in practically all of the papers. The editors of the *Railway Mechanical Engineer* appreciate the response of every one of the contributors to the announcements of this contest.

Speeding Up Car Repair Work

The volume of car repair work at rip tracks and car shops in this country is so great as to justify the large amount of attention given to many different plans for handling it and decreasing its unit cost. In recent months attention has centered primarily on straight line methods, and one of the most important advantages of practically any straight line method is the possibility which it provides of friendly competition between specialized gangs performing similar work. This organization is perhaps difficult to bring about at a rip track or small car repair shop handling light repairs, although it is probable that even in this case the use of straight line methods and specially trained men in competing gangs can be more generally adopted than at present. Wherever it is possible to put through the car shop a series of cars of similar type and requiring the same class of repairs, however, the possibilities of friendly competition between the gangs represents an unquestionable opportunity to increase the shop output. In many cases experience has shown that these cars can be started on their straight line movement over two or more parallel tracks. Necessarily the movement of the cars on each track must be made at the same time, which means that all the gangs on each track must complete their work simultaneously or hold up the entire track. Moreover, if the parallel track movements are made at the same time, there is a possibility of cross competition between the gangs on the respective tracks, with a highly favorable effect on shop output. It is an unquestioned trait of human nature that competition stimulates interest, and, while the result is undoubtedly increased production and harder work on the part of the men, the introduction of competitive gangs tends to promote renewed interest in the work; time passes more quickly; and the workmen are less fatigued mentally and perhaps also physically than if they spend the day watching the clock and trying to keep out of the sight of their foremen. No progressive railroad management in touch with the trend of the times has any idea of stimulating shopmen's activities beyond a point which can be maintained from day to day without harmful effects. There is no question, however, that within reasonable limits the competition between specialized gangs of car workers can be developed with a desirable effect on shop output and improved morale of the shop workers themselves.

Intelligent Locomotive Work Reports

Unintelligent, poorly written, finger marked enginemen's work reports are handed in all over the country, day in and day out, and constitute a hindrance to the enginehouse foreman in his task of keeping power in serviceable condition. "Driving boxes pound badly," "valves out of square," "engine does not steam," and such general statements do not mean a thing to an enginehouse foreman. An analysis of such reports generally shows that the older enginemen are the most serious offenders. It is an easy matter for the inspectors at the inspection pit to locate the apparent, external defects but it is the engineman's duty intelligently to report the defects existing on a locomotive under working conditions. It is assumed that when a fireman is promoted, he has a fairly good working knowledge of the machinery of a locomotive. An engineman consequently should specify in his work report what driving box is pounding, what valve and in which position does it work out of square, under just what conditions does the engine blow, and if the engine does not steam properly, why did it fail to steam. These and many other defects are of such a nature as to cause the enginehouse foreman and his men to lose their tempers as well as time and money for the company in trying definitely to locate the defects reported. Again, some enginemen know how to make out an intelligent report but scribble it down in such a manner that it is almost impossible to read it. If the engineman would take a little time to wipe the grease from his hands he could hand in a clean report instead of one smeared with greasy finger marks. Such reports tend greatly to hinder the making of proper repairs which, in turn, leads to engine failure on the road. To overcome this trouble steps should be taken to educate the enginemen as to just what is required of them in regard to making out work reports, and if they continue to hand in unsatisfactory reports disciplinary action should be taken so that satisfactory results may be obtained. The enginehouse foreman is frequently called on to answer for engine failures due to improper repairs. Would it not be time well spent by the higher officers of the department to attack aggressively one of the causes of these failures by making the enginemen hand in proper work reports, through closer supervision of these men on the part of the road foreman of engines?

New Books

An Investigation of the Fatigue of Metals. *By H. F. Moore, research professor of engineering materials, University of Illinois Engineering Experiment Station, and T. M. Jasper, Research assistant professor of engineering materials. University of Illinois Engineering Experiment Station. 88 pages, 6 in. by 9 in. Price 45 cents. Published by The University of Illinois, Urbana, Ill.*

Bulletin No. 142 gives a detailed discussion of the theory of the fatigue of metals and substantiates the theory by numerous tests made in the testing laboratory. A chapter is devoted to resistance to reversed axial stress and also resistance to repeated stress other than reversed stress. The testing machines used to make the tests are fully described by text and illustrations. The test specimens used are recorded in tabular form giving the physical properties and preparation of each piece used. The text contains tables and graphs which give the data and results of each test. The summary of conclusions is given in ten paragraphs which are based on direct experimental evidence. The following facts are brought out in the conclusions. The endurance limits of wrought ferrous metals are much greater than originally thought to be. Repeated stress at or below the original endurance limit of a wrought ferrous metal raises the endurance limit of that metal and a repeated stress above the endurance limit lowers it. It is recommended that the endurance limit of the metal under reversed axial stress be considered as 60 per cent of the endurance limit under reversed flexural stress. An appendix to the Bulletin gives a supplementary bibliography containing the names of 55 articles dealing with the fatigue of metals. The subject is thoroughly discussed from every angle and the bulletin will prove a valuable aid to those who are interested in the fatigue of metals.

Making Letters Talk Business. *Edited by Sherman Perry, 184 pages, 6 in. by 9 in. Prepared and published by The American Rolling Mill Company, Middletown, Ohio.*

This book covers points of vital importance to the correspondent and the stenographer in the development of teamwork to the end that the letters may become more resultful. The text of the book brings out forcefully the absolute necessity of courtesy and naturalness in writing letters. A sample business letter is taken and the essential principles are discussed in such a way as to point out the most correct and effective practices. A chapter of the book is devoted to the Gregg shorthand method, giving the syllable division, and the primary and secondary accents used in the system. The principles of essential English as applied to business letters is thoughtfully discussed. Four pages of prepositions and their uses are included in the text. Throughout the book are scattered quotations, axioms and sayings which give the views and ideas of the best known writers and publications of the advantages of using the English language correctly so as to make business letters effective. It is a practical, well arranged book from which those who handle correspondence can receive many helpful suggestions.

What Our Readers Think

Consideration for the Hot Worker

Lorain, Ohio.

To the Editor:

Only those who have filled the position of hot worker in a roundhouse have any real conception of the disagreeable features attendant on that position. These very evident features are so closely allied with it that to some supervisors it has practically amounted to a visualization of both the job and the holder as being minor agencies in the upkeep of engines in service. A greater fallacy could not exist.

There are two positions in a roundhouse that should be considered of the first importance—the hot worker and the boiler inspector. Unhappily such is not the case in the estimation of many who have charge of enginehouses. The consequences of filling both of these positions without consideration of the worker's qualifications have been both disastrous and expensive. The question arises: What constitutes a good hot worker? Answer: A good boiler maker. It is not exactly necessary that the hot worker should be a flanger or a layer-out, but he should be a man who has served his time as a shop boiler maker and a man with good judgment. A good hot worker knows that it is better to roll a flue that has developed cracks from the bead back into the flue than it is to take a fuller and calk the crack together as one would do with a fire crack in a flange or elsewhere. He also knows how much leaking staybolts should be hammered or worked over with the rivet pin, expecially if it is a full installation of flexible bolts. Good judgment is required there for too much hammering has a tendency to draw the sheet, thereby loosening up the adjacent bolts. Cracks in firedoor necks and elsewhere are taken care of in a manner

that will keep the engine in service until its regular shopping period.

He has his eyes open for leaking units at the firebox end, also for cracked or broken grates, mud blisters on the crown sheet and arch tubes, air leaks at front door ring, ash pan slides that do not close tight; he looks out for lost motion in the ash pan lever and shaft; sees that netting and plates in the front end are in good condition; that the blower is in position and in good repair. In some cases he has more than is here outlined, but enough has been covered to show how important the job is and how necessary it is that the hot worker be given the consideration that he deserves. There isn't much comfort in the job, but it can be made more pleasant by a little consideration.

He should have time to cool off before being called down on the floor for some other duty, and if he should happen to be caught taking it easy on the engine man's seat, don't bawl him out; he has probably just come out of the firebox where, surrounded by hot arch brick, leaking crown bolts dropping hot spots down his neck, flues spraying him with steam and hot water, the temptation has assailed him to forget that he is a boiler maker and for the moment become a butcher.

JOSEPH SMITH.

A Question and Answer

WINNIPEG, Man.

TO THE EDITOR:

It is customary in the shops where I work to rig up small hydraulic presses for pressing in bushings and such work. These presses are often made with the steam cylinder of an air pump as the driving power. My problem is, if the diameter of the steam cylinder is known to be 9¾ in., the steam pressure 100 lb. per sq. in., the size of the ram is 6 in. in diameter and the desired pressure 85 tons on the 6 in. ram, is it possible with this information, only, to find the diameter of the water cylinder required to give the desired pressure on the ram.

F. O. ROBINSON.

[You have a 9¾-in. steam cylinder with 100 lb. steam pressure per sq. in. By calculating the area of the 9¾-in. circle and multiplying this by the steam pressure, you will have the maximum possible piston load produced by the steam cylinder. Going now to the press, you can determine the water pressure per sq. in. required by calculating the area of the 6-in. ram and dividing this into the desired ram pressure of 85 tons. Having obtained this unit pressure and knowing the total load produced by the steam piston, if you divide the former into the latter you will have the area of the water cylinder plunger required. To find the diameter required you can readily find the diameter of the circle which equals this area. The figures thus obtained make no allowance for loss due to friction or other causes and to be on the safe side you would probably have to make some allowance.—THE EDITOR.]

Cutting Port Openings in Cylinder Bushings

CHICAGO.

TO THE EDITOR:

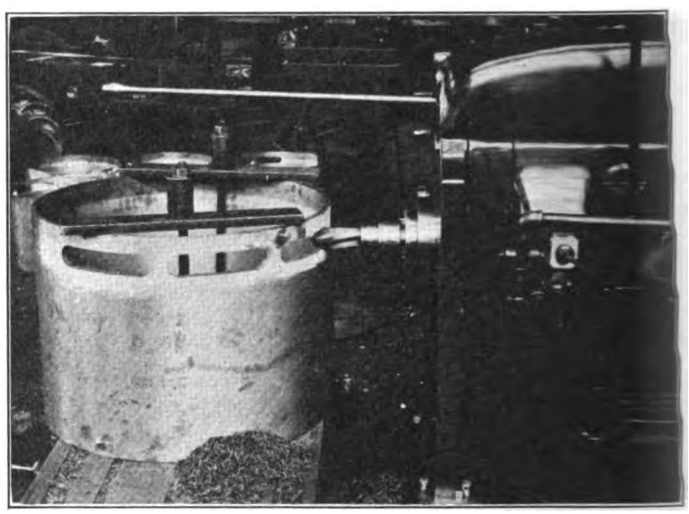
The illustration shows a method of cutting the port openings in locomotive cylinder bushings that may be of interest to those of your readers who are concerned with that particular job. It shows a Hunt-Spiller cylinder bushing held in place by two bolts and clamps. The only laying out necessary is for one hole at each end of the port openings.

A combined high speed steel drill and milling cutter is used to first drill the 1¾ in. hole, then the bushing is fed along the tool until the opening is completed. The clamps are then loosened and the bushing is moved into the correct position for milling the next opening, and so on until completed. The bushings shown in the illustration have three openings, each 7 in. long x 1¾ in. wide. These openings can be drilled and milled complete from floor to floor in less than 15 minutes.

It may be said that this work should be performed on a revolving circular table, but after trying out this method I do not think it is really essential, especially since in most cases the table would have to be placed in position for a small number of bushings and not all railroad shops are equipped with these devices.

The cutter was made from a milling cutter that broke while it was being used for milling the fork ends of a side rod. The broken end appeared almost like the one shown in the illustration and suggested itself for this sort of work, so it was ground and successfully tried out.

I have observed this particular operation being performed in various ways, many of which took anywhere from one to three hours to complete. I was recently in a shop where the openings were carefully laid off and the bushing placed on a drill press where several holes were drilled. Small holes were even drilled between the large ones and the bushing was then placed on a milling machine where the job was completed. Examples can also be cited where a hole equal to the width of the port was drilled in each end of the opening and then finished on a milling machine. Considerable embarrassment was caused when the foreman was

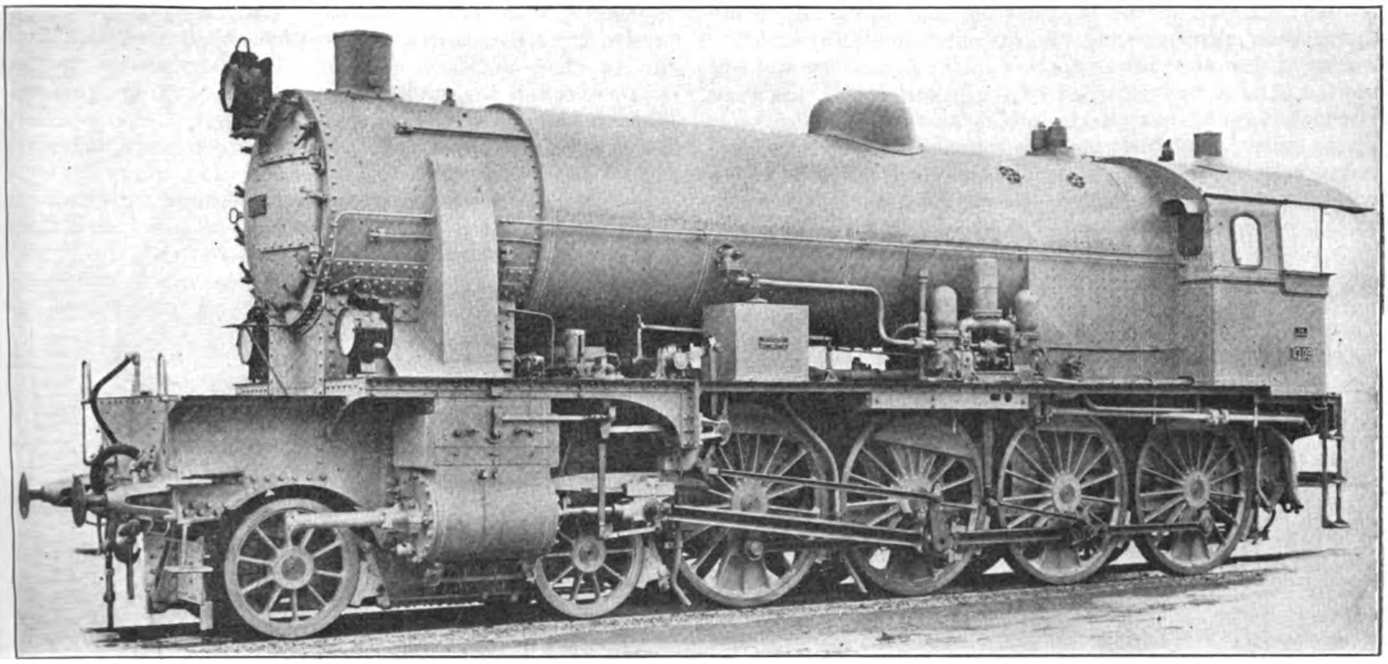


Cutting Port Openings in a Cylinder Bushing with a Combined Drill and Milling Cutter

asked why the second hole was necessary in each port when the milling cutter could complete it just as well without the second hole.

While on the subject of cylinder bushings, I have frequently wondered why some roads follow the practice of making them in one piece. This entails considerable extra labor to machine and they are also difficult to apply and remove. The half length shown in the illustration can be bored, counterbored, turned and cut off in one operation on a vertical boring mill. I have been told that the inside of a one piece bushing which is first bored on one machine, and then the center plates applied and turned to a fit on a lathe, will tend to become so distorted that it is usually necessary to rebore after application. If the cylinder is round before the application of the two piece bushings, it is not necessary to rebore them when pressed in. Of course, care must be taken in facing them so as to get the faces true where the bushings join together.

OBSERVER.



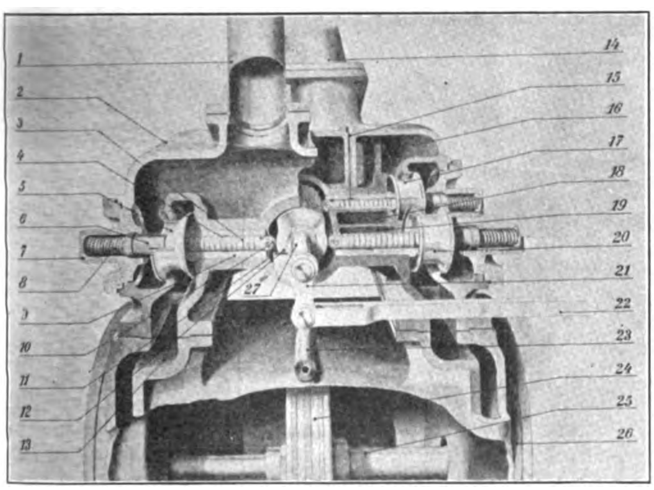
A 4-8-0 Superheated Express Passenger Locomotive Used on the Austrian Federal Railway, Equipped with the Lentz Poppet Valve Gear and the Dabeg Feed Water Heater.

Development of the Lentz Poppet Valve Gear

Valve Gear Maintenance Costs, Lubricant, and Water Consumption Reduced on Austrian Locomotives

By A. Niklitchek

THE Austrian Federal Railways have succeeded in greatly increasing the efficiency of the modern reciprocating steam locomotive by the application of the poppet valve gear in place of the customary piston valves. At the present time the piston valves are applied only to very light power or to that designed for the highest speed.



1—Inlet pipe; 2—Poppet chest; 3—Poppet spindle; 4—Spindle Grooves; 5—Inlet valve; 6—Spindle guide; 7—Spring cover; 8—Poppet spring; 9—Poppet spindle guide bushing; 10—Poppet roller; 11—Cam space; 12—Inlet cam; 13—Inlet port; 14—Exhaust pipe; 15—Lubricating groove; 16—Exhaust port; 17—Exhaust valve; 18—Exhaust port; 19—Inlet port; 20—Inlet valve; 21—Cam shaft arm; 22—Cam shaft arm connecting rod; 23—Cylinder lubricating pipe; 24—Piston; 25—Piston rod; 26—Cylinder; 27—Cam shaft.

Fig. 1—Arrangement of the Lentz Poppet Valve Gear

Austrian locomotive designers for a long time had experimented with the poppet valve gear but had been unsuccessful in developing one which could meet the difficult service requirements of locomotives. Nevertheless they continued their efforts in the belief that the piston valve, with its high maintenance costs, resistance to motion and steam losses, was a very inefficient means of steam distribution. The long delay experienced in applying the poppet valve to the locomotive was due to the defective design of the whole gear. The poppet valve, which had long proved its efficiency on the reciprocating stationary engine, was difficult to adapt to the severe and irregular conditions met with on the locomotive.

After many years of experimenting at the Steg Locomotive Works, Vienna, with which company the Austrian Federal Railways and the Southern Railway of Austria co-operated, it is believed that the problem of the application of the poppet valve to locomotives has been solved and that the design developed has had sufficient trial to prove its ability to meet every operating requirement.

Since 1922 all new locomotives ordered by the Austrian Federal Railways have been equipped with the Lentz poppet valve gear. Locomotives so equipped have been handling heavy traffic on the steep gradients of the Austrian Alps without any difficulty. The consumption of coal and lubricants has been materially decreased by the application of these valves and valve gear maintenance costs on these locomotives have been reduced to practically nothing. When it is recalled that the Austrian railways have to import nearly three-fourths of all their fuel, it is apparent that the attention paid to fuel economy has been well placed.

Description of the Valve

Fig. 1 gives the details of the Lentz valve gear as used on the Austrian Federal Railways, showing the upper part

of the cylinder and the poppet chest containing the steam-distributing elements—the poppets, the cam shaft and the cams. There are four poppets, one for admission and one for the exhaust for each side of the piston. The cam shaft is engaged by a lever attached by means of a Woodruff key at its outer end, which lever is actuated by the connecting rod of the gear. The device is designed for application with any type of valve motion, so that modernizing antiquated power by the application of the poppet valves will not necessitate the provision of new valve motion. The separation of the introduction and exhaust of steam secures the well known thermic advantages.

The poppet valve chest is of cast iron and includes the channels, seats and partition walls for the poppets and holes for the guidance of the poppet spindles. It is fixed on the cylinder by means of two flanges. The poppets are of the double-seated balanced pattern and, in order to reduce their weight, they are drop-forged. The thickness of the walls is only 1/8 in. Experiments are now being conducted with poppets of a high grade of cast iron. The poppets are guided by a hollow spindle, made of chrome-nickel steel, the end of which is provided with a roller of hardened steel which makes the contact with the cam. The labyrinth protects against steam losses caused by blowing between the spindles and guides.

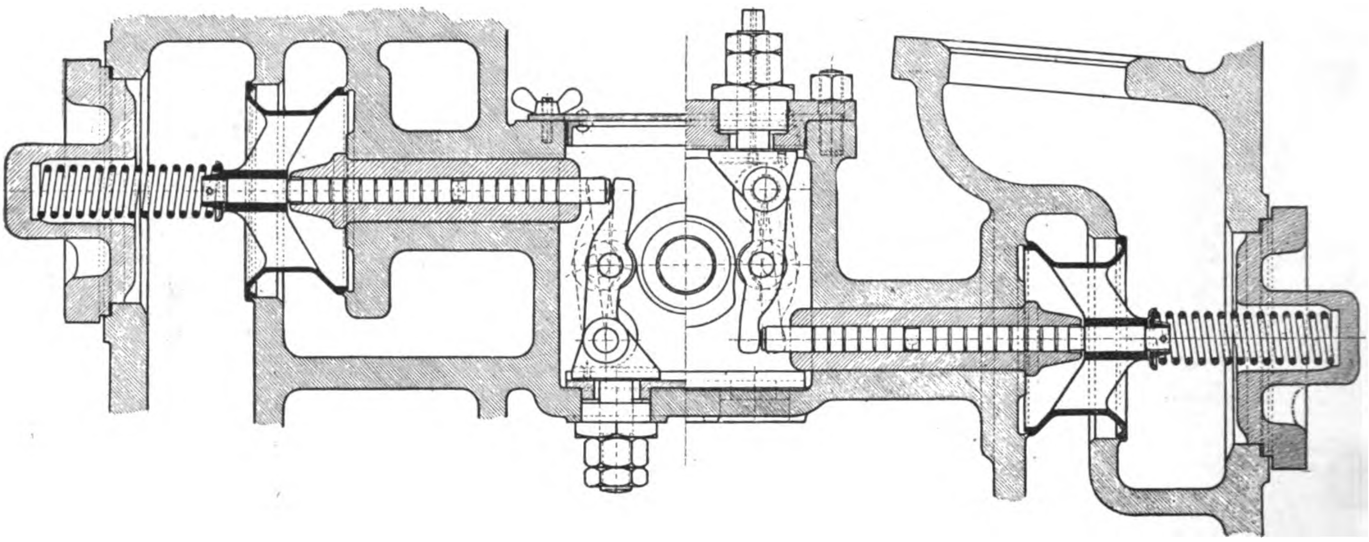


Fig. 2—Poppet Valve Gear with Intermediate Lever Located Between the Cam and the Poppet Spindle

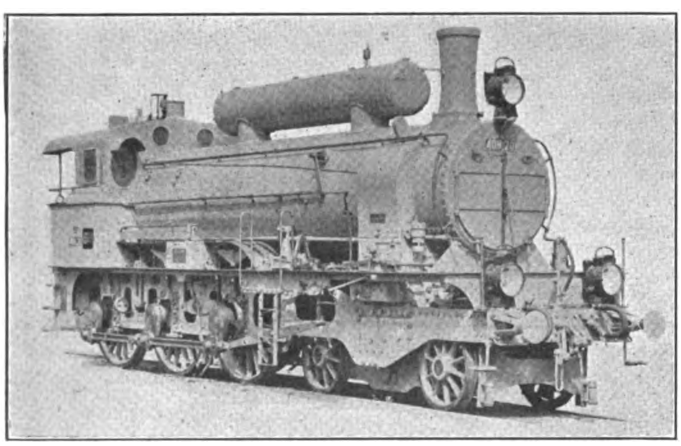


Fig. 3—Superheated Passenger Locomotive Rebuilt and Equipped with the Lentz Valve Gear

Each poppet is, as shown in Fig. 1, pressed upon its seat by a spring. The tension of this spring is so proportioned as to secure contact between the lever and the cam even at excessive speed such as 400 r.p.m. Before the locomotive leaves the shop the poppets are adjusted on their seats. If there is any blowing in operation the poppets have to be readjusted. The application of fine steel discs between the poppet and its spindle, which can be easily removed, simplifies this operation.

Another device which is used in connection with this gear is shown in Fig. 2. These are intermediate levers located between the cam and the poppet spindle. They have a double function—first, the lengthening of the poppet stroke and, second, they give an opportunity for accurate regulation of the beginning of the poppet stroke.

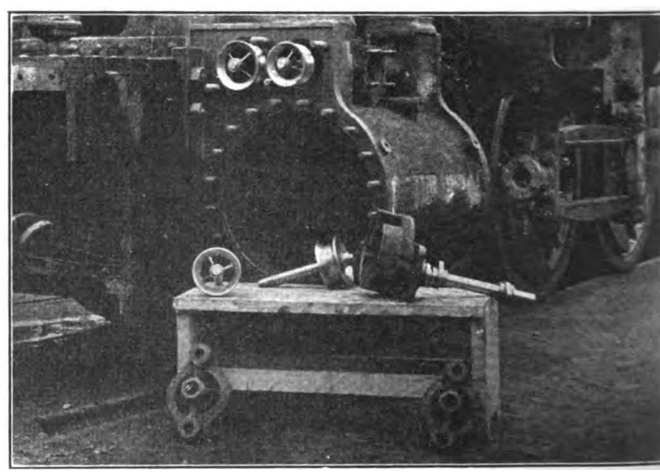


Fig. 4—The Four Poppets and the Cam Shaft of the Lentz Valve Gear

The Austrian Federal Railways have made thorough tests of locomotives of the same class, some equipped with the poppet valve and others with the piston valve. The locomotives thus tested are of the 2-10-0 heavy freight type. These tests have shown that the chief advantage of the poppet valve consists in the reduction of repair and maintenance costs, 40 per cent to 50 per cent decrease in the consumption of lubricants, and fuel and water economy averages of from five to eight per cent.

Many of the locomotives equipped with a poppet valve gear have also a Schmidt small tube superheater which delivers steam to the valve chamber at from 820 deg. to 840 deg. Fahr. The tests of the locomotives equipped with this type

of superheater have not as yet been completed, so that definite results cannot be given. The performance of this type of superheater, however, seems to depend largely on the length of the boiler and the quality of the coal. It has been found that the superheater does not perform at its maximum efficiency when brown coal is used.

Excellent results have been obtained with old locomotives which have been modernized by the application of the superheater and the poppet valve gear. Fig. 3 shows a rebuilt 4-6-0 type of the Austrian Southern Railway which has been equipped with a small tube superheater, poppet valve gear and a Dabeg feed water heater. This locomotive is now able to handle the same traffic as locomotives with the same wheel arrangement which were built 15 years later. The tractive effort of this locomotive has been increased 40 per cent, showing clearly the advantages of the use of highly superheated steam. At the present time there are 42 locomotives equipped with the Lentz poppet valve gear.

Fig. 4 shows the principal parts of the poppet valve gear. One exhaust and one inlet poppet valve extend from the steam chest. On the bench is shown the cam shaft containing the inlet and exhaust cams. These cams are made from chrome-nickel steel. The illustration also gives a good idea of the accessibility to the various parts of the gear.

Analysis of Feed Water Heating Devices

Feed Water Heaters with Pumps Take More Heat from the Exhaust Than the Exhaust Steam Injector Type

By E. P. Gangewere

DURING the last few years, considerable activity has been manifested in locomotive feed-water heating. Broadly speaking, devices on engines today, may be divided into two classes: feed-water heaters with pumps, and exhaust steam injectors.

In order to fully understand the savings afforded by each of the above devices, it might be well to study the heat interchanges involved in their use. This will, of course, not deal with the mechanical construction, or operation of either device. As is well known, steam under pressure has energy by virtue of two conditions; namely, kinetic energy, or that part capable of doing external work, and potential energy, or that part which is due primarily to the heat in the steam. The feedwater-heater pump and exhaust steam injector use both energies of the steam, to various extents.

In order to better illustrate the points at hand, a typical set of figures has been taken. We will first consider the exhaust injector:

Boiler pressure (gage) .... 200 lb.
Heat in steam at 215 lb. abs .... 1199.2 B.t.u.
Exhaust steam from cylinders of locomotive (at 15 lb. gage back pressure, initial temp. 625 deg. F.) .... 1163.9 B.t.u.
Assumed tender water temperature .... 38 deg. F.

Considering the first stage of operation of the injector, the exhaust steam, and water from the tender, are here mixed together.

Temperature of delivery from first stage (assumed) .... 140 deg. F.

Since the heat lost by a body during a heat transfer cycle, must equal the heat regained by another body, we have:

W_t equal weight of water from the tender.
$1163.7 - (140 - 32) = W_t\ (140 - 38)$, or
$W_t = 10.3$ lb. per lb. of exhaust steam from the cylinders.

In the second stage of injector the previous mixture is here augmented by live steam from the boiler. The mixture entering the second stage consists of 10.3 lb. of tank water and 1 lb. of exhaust steam. Since the combining tube ratio must remain the same, we can compute the final delivery temperature from the following formula:

T = final delivery temperature.
W_1 = weight of live steam.
W_m = weight of mixture (tank and exhaust steam water).
W_{ex} = weigh of exhaust steam.

Hence:
$(T - 140)\ 11.3 = W_1\ (1199.2 - 140 - 32)$, and

$$\frac{W_1}{W_m} = \frac{W_{ex}}{W_t} = \frac{1}{10.3}$$

Since $W_m = 11.3$ lb. and $W_1 = 1.1$ lb. live steam.

Therefore from above equation:

T = 244 deg. F.

Assuming that the exhaust steam from the cylinders and water from the tank was lifted a distance of 10 ft., the external work performed would be 10 x 11.3 = 113 ft.-lb.

Internal work performed would be 1199.2—(244—140) = 1095.2 B.t.u. transferred to the feed mixture, per lb. of live steam used.

Heat in steam at 215 lb. abs .... 1199.2 B.t.u.

Allowing the pump exhaust to heat the water from the tank, this being a condition when the locomotive might be drifting, with no exhaust steam from the cylinders.

Assume in this case:
Feed temperature, = (0 deg. F.
Pump exhaust back pressure, same as cylinder back pressure when the engine is working = 15 lb. gage.
Assume adiabatic expansion to 15 lb. gage; heat in the steam = 1050 B.t.u.
Hence: $1050 - (60 - 32)\ W_1 = W_t\ (80 - 32)$.
$W_1 = 1$ lb. live steam.
$W_t = 36.5$ lb. tank water.

Now utilizing the cylinder exhaust at the above back pressure, and assuming a final delivery of 210 deg. F., and that quantity of exhaust reclaimed is in each case proportional to the increase in fluid temperature; we have:

$(210 - 60)\ 37.5 = W_{ex}\ (1163.7 - 60 - 32)$, or $W_{ex} = 4.86$ lb. exhaust steam from the locomotive cylinders.

The external work performed is 10 (36.5 + 4.8) = 413 ft. lb. The internal work performed is 1050 — (60 — 38) = 1028 B.t.u.

From this analysis we draw the following conclusions:

The total work of the injector per lb. of live steam is (1095.2 × 778) + 113 = 852,178 ft.-lb. The total work of the pump per lb. of live steam is (1028 × 778) + 413.0 = 800,197 ft.-lb. or 51,981 ft.-lb. in favor of the injector.

Considering the results of the analyses on an exhaust steam reclaimed basis. For the injector the amount reclaimed per lb. of live steam used is $\frac{1}{1.1}$, or .9 lb. For the pump, the amount reclaimed per lb. of live steam used is 4.8 lb., by previous calculation.

The total heat reclaimed from exhaust steam by the injector is .9 (140 — 38) = 91.8 B.t.u. The total heat reclaimed from exhaust steam by the pump is 4.8 (210 — 60) = 720 B.t.u. The above figures are based on 1 lb. live steam consumption.

The real criterion of efficiency, then is the amount of heat reclaimed from the exhaust steam per lb. of live steam used. Practical advantages, however, will determine in all cases, which device might be used on a locomotive.

Relation of Locomotive Design to Maintenance

Proper Consideration Given to Design of Parts Facilitates Repairs at Reduced Cost

By Charles Raitt
Assistant Master Mechanic, A. T. & S. F., Prescott, Ariz.

THE relation of design to maintenance is a vital one on locomotives. As soon as a locomotive leaves the builders' or the repair shop and enters service the process of wear begins and adjustments, repairs, or renewal of parts are needed to keep it in good condition. The facility with which these adjustments, etc., can be made in great measure determines the cost; the design and arrangement of parts determines the ease or difficulty experienced in adjusting, repairing, or renewing them, and is, therefore, of first importance.

There are so many designs of locomotives in service that it is difficult to treat the subject constructively and to avoid a general discussion of theories as applied to different types rather than to deal with it from the point of view of the running repair force which is the registrar of the cost of locomotive maintenance to the management of the railroad.

The vital importance attached to the fact that the design and accessibility of locomotive parts has a direct bearing on maintenance cost is emphasized in this article in such a manner that the designer can hardly fail to recognize an opportunity to make his work a big factor in the reduction of maintenance expense.

Generally speaking there is no pronounced difference of design between passenger and freight locomotives, yet the difference is such as to affect materially the cost of maintenance. The height of driving wheels on passenger power renders accessible for repairs many parts which present quite a problem on low wheel freight locomotives of the 2-8-2 or 2-10-2 type, particularly the spring rigging, driving brake equipment, attachments between frame and boiler, decks and cross frame braces. Too frequently a common design is followed without regard to the fact that the larger number of low wheels, almost totally blanked with counterbalances, and closer centers renders access easy on the one and a laborious task on the other. The balance in favor of maintenance cost of passenger locomotives is largely due to that fact.

Some of the heavier machinery maintenance items common to all classes of power are main driving box pounds, adjustment and securing of driving wedges, and taking up lateral on engine truck and trailer wheels. Increasing the size and length of main bearings adds to their life, but it must be admitted that the refitting of main brasses every 15,000 to 25,000 miles on heavy freight power, and from 35,000 to 50,000 miles on passenger locomotives indicates a lack of balance yet to be solved. The three-piece main brass with adjustable parts to take up wear may give some relief, but it would seem that a transfer of weight to the other drivers, with corresponding counterbalance and rod strength, is the way out. The wedge bolt as a means of adjusting and holding driving box wedges, is admittedly poor, ineffective and expensive and it is often necessary to supplement it with blocks between the wedge and binder to get results. On roads with sharp curves the enginehouse truck gang has a perpetual job removing engine truck and trailer wheels to take up lateral. A design of box is needed, fitted up for removable hub plates that will be easy to apply without removing the wheels or boxes. This has been successfully worked out on some roads but its value is not generally recognized.

Frame and Boiler Connections

Loose deck castings and cross frame braces demand expensive repairs. They have increased as cast steel has replaced iron castings. The greater strength of the steel permits a proportionate reduction in weight with the result that the web or flange where it is bolted to the frame is often too light to give holding surface for the bolts, so they work loose and holes have to be re-reamed and new bolts applied at intervals. A built-up hub is required around the holes to insure material enough to resist bolt wear.

Periodical and expensive repairs are required to maintain braces between the main frames and the boiler. These connections are usually made by fastening twin angle irons to the barrel of the boiler with studs or rivets, then bolting a piece of boiler plate between the angles. The bolts at the angle irons bear all the upward thrust of the frames, soon break or become loose, and, very often, start the studs or rivets leaking in the boiler. Experience has shown that there is not only no advantage in having braces between the frames and the boiler studded to the boiler but that it weakens the boiler sheet and induces cracks between the stud holes which require expensive repairs. It has been demonstrated that where these attachments are required, such as at the overhang of guide yokes and valve gear supports, the boiler should be reinforced originally at the point where the brackets are attached, and the supporting brace hinged to take care of boiler expansion without undue strain.

The furnace bearers or expansion rests between the fire box and the frames are a prolific source of trouble, and are neglected more than they should be. As a rule they are too short, have no provision for lubrication and, as a consequence, grind loose and allow a jumping motion between the frames and the boiler which makes a hard riding engine. When the upper part of the pad or rest is shorter than the lower it grinds downward. In the absence of other means of correcting this, sheet iron shims are provided to take up the slack which, as a rule, are applied on top of the shoe because it is the easiest way. In time this creates a heavy strain between the boiler and the frame which prevents free expansion of the boiler. A case came to my observation some time ago where the upper parts had ground into the lower over 1/4 in. with a square shoulder at each end of the worn surface. They were shimmed down and when the boiler was fired up, prevented expansion until the strain became so great that when released suddenly it ruptured the boiler sheet through 26 rivet holes at the second course connection. The importance of having furnace bearers of adequate design to insure free movement is, therefore, apparent.

Spring Rigging and Brake Equipment

The maintenance cost of spring rigging on certain classes of power is perhaps more than any other one feature governed by design. The free movement of springs in saddles and a means of lubricating equalizer and hanger pins should be provided. These pins should not be doweled or rigidly held for, if left free and oiled, they will be found to turn, thus improving the riding of the engine as well as doubling the life of the pins. Slotted spring hangers passing through spring ends and supported by narrow gibs should be replaced by hangars passing around the spring with a suitable steel clip casting between the spring and the hangers. All hanger pins should be placed so that new springs can be applied without the necessity of jacking up wheels or removing other frame attachments.

The suspension pins of driving brake hangers are very often a source of trouble on freight locomotives on account of being placed behind the tires and applied from the outside. Safety hangers and brake rods frequently interfere with the packing of driving box cellars. These conditions can be remedied if given consideration by the designer. Trailer and engine truck braces should also be located so as not to interfere with a quick job of applying a brass or packing a cellar on the road.

Revolving and Reciprocating Parts

Of the many designs of back end main rod connections, that type with the adjusting bolt threaded through the adjusting wedge is probably the least desirable as the thread becomes distorted by the thrust. The strap connection is too cumbersome on heavy power and the strap bolts hard to remove and replace. The solid end and floating bushings in both main rods and main connections are economical by reason of convenience in renewing, and, if properly fitted, will give 20,000 miles service on the heaviest power. The short bearing of side rod knuckle joints involves frequent renewal of pins and bushings, but because of the limited wheel clearance it affords little chance of improvement, except in the matter of providing lubrication, which is often neglected.

Of the two types of two-bar crossheads now in general use the alligator type is the most economical on account of centering up with the cylinder. When constructed so that the outer plate can be removed and gibs shimmed or renewed instead of having to remove and babbitt the spacing blocks, it effects a decided saving in maintenance cost. The two-bar type crosshead with underhung piston requires much heavier guide bars, and should be reinforced with a cast web underneath and just back of the wrist pin, and with another at the extreme rear end under the bottom guide bar to prevent overstrain on the sides when the wrist pin is tightened. This is to avoid vibration cracks under strain as well as to prevent cramping the front end of the main rod.

The universal use of superheated steam has revolutionized piston construction. The solid piston head is almost extinct and the cap style follower bolt on built-up heads is gradually vanishing, taking the old snap ring with it. Bull rings with from two to three inches added material in the lower segment to withstand wear, with concave cylinder heads to provide clearance for it, add very much to the life of piston heads and permits of their being built up substantially. Follower plates fastened with through bolts simplify the removal of bull rings, and section cylinder packing with steel expander rings seems to be the most serviceable and economical piston construction to date.

Proceedings of the Railway Fuel Association

A Large Attendance with a Heavy and Varied Program Marks the Sixteenth Annual Convention

MORE than 700 members were in attendance at the Sixteenth Annual Convention of the International Railway Fuel Association, which was held at the Hotel Sherman, Chicago, May 26 to 29 inclusive. The interest of the members was sustained throughout a heavy program covering all phases of the railway fuel problem, from the selection and inspection of coal at the mine to the proper firing practice in the final consumption of both oil and coal on the locomotive.

The principal features of the opening session were the addresses by R. H. Aishton, president of the American Railway Association, and Charles Donnelly, president of the Northern Pacific. Mr. Aishton's address, reported in some detail, follows. Mr. Donnelly devoted his remarks to the proposed consolidation of railroads into a limited number of systems as outlined in the Transportation Act. The association was also addressed by G. W. Reed, vice-president of the Peabody Coal Company, Chicago, and M. A. Daly, president.

President Daly outlined the history of the Fuel Association accomplishments during the last year, describing the important results secured by the prize contest for the best paper on fuel economy. He referred to the growth of the International Railway Fuel Association in size and said that it has come to be regarded as an authority on fuel matters, having received such recognition by the American Railway Association, the Bureau of Railway Economics and the Interstate Commerce Commission.

Election of Officers

The following officers were elected for the coming year: President, P. E. Bast, Fuel Engineer, Delaware & Hudson; vice-president, E. E. Chapman, engineer of tests, Atchison, Topeka & Santa Fe; vice-president, J. W. Dodge, Illinois Central; vice-president, J. R. Evans, chief fuel supervisor, Chesapeake & Ohio. The following new members were elected to the Executive Committee: O. J. Brown, superintendent fuel service, Boston & Maine, two years; T. C. Hudson, assistant general superintendent motive power, Canadian National, two years; A. W. Perley, Oregon-Washington Railroad & Navigation Company, two years; W. J. Tapp, fuel supervisor, Denver & Rio Grande Western, two years; and J. M. Johnston, fuel supervisor, Missouri-Kansas-Texas, one year. The association voted to hold its 1925 convention at Chicago.

Mr. Aishton's Address

Equally with everybody connected with the railroad service, and with the public who are dependent on its use, you are also vitally interested in the future destinies of the railroads, their success or failure, and I know of no body of men who have any greater individual influence on their welfare than you and your associates on the battle line of the railways who have to do with the fuel problem.

What is your problem? Considering the aggregate of

the coal used on the Class I railroads of this country the figures are so startling that we are apt to get lost, and the use of such figures suggests enormous and unlimited sources of supply. I am just going to quote a few figures to paint the picture:

Total fuel consumption, 1923 (includes fuel oil, equated)	146,500,000 tons
Made up as follows:	
Freight	90,000,000 tons
Passenger	32,000,000 tons
Switch	24,500,000 tons
Total	146,500,000 tons
Total cost	$507,000,000
Average cost fuel per ton, all fuel	3.46

You are all familiar with the measure of freight service, commonly called 1,000 gross ton-miles. One of the large measures of efficiency and economy in moving a thousand tons a mile is how much coal is burned in that operation. Last year it took 160.2 lb. of coal turned into steam to move one ton of gross freight 1,000 miles, or 1,000 gross tons one mile, which, by the way, is 2.8 lb. less than 1922 and 1.8 lb. less than 1921.

I have in my hand a pound of coal. It doesn't amount to much in looks, and few of us would stoop to pick it up or refrain from kicking it down the bank, but in that one pound of coal as applied to 1,000 ton-miles lies the greatest opportunity for economy that I know of. I won't say how many millions or billions of ton-miles were made in the course of the year. Suffice it to say that if you were to move a ton of gross freight 1,000 miles, and did it with that pound of coal less than you used in 1923, and moved the same ton mileage as in 1923, you would have saved in the aggregate 561,987 tons of coal, which at the prevailing price would mean $1,944,000 less than in 1923. Is that worth going after? You men know better than I how you can do it. In the same way, applying that same degree of saving, one pound of coal out of every 160.2 lb. used in passenger service, would save 200,000 tons of coal valued at $692,000. If you applied that same degree of saving to the fuel used in switch service and for other purposes, such as stationary boilers, stations and for heating purposes, etc., it would mean a further saving of 153,000 tons, or $529,000, making an imposing total of $3,165,000 less cost than would have been incurred provided the same amount of fuel was consumed per 1,000 ton-miles as in 1923.

We hear a great deal nowadays regarding scientific investigation, development of methods and appliances for bringing about wholesale greater economies in fuel, and while they may and no doubt do possess possibilities, in my opinion we must take cognizance of the fact that they all have one present vital disadvantage and that may be briefly expressed in the term, capital expenditures. Capital expenditures depend on the earning power of a railroad, and unless the necessary capital can be secured at reasonable terms —and this is, in turn, dependent on the net revenue of the railways—it is absolutely futile to talk about large capital expenditures until conditions improve, although we all may know that such expenditures would produce a good return to the railroads.

Furthermore, do not overlook the fact that in the last two decades every known appliance for producing economy has been installed on new locomotives and to a very large extent on the larger locomotives as they go through the shops, and while I won't undertake to say what the total capital expenditure has been, in the matter of superheaters alone it runs up over $125,000,000, and in 1923 there was programmed and being installed superheaters to the value of practically $7,000,000. In addition to that, large amounts of capital have been put into brick arches, stokers, coal breaking appliances, self-closing firebox doors and all the appliances with which you are familiar that it is claimed add to economy, besides liberal installation of numerous experimental devices not yet proved but which may lead to economies in labor and fuel costs.

What we have got first and immediately to attack is the problem as it is—the tools as they are in our hands today—and by the application of knowledge, initiative, and a desire to bring about accomplishment, get an immediate result out of these vast capital expenditures. There is hardly an activity or an employee in any department of the railroads who does not have an opportunity to save on fuel consumption and to play his particular part in saving that pound of coal.


M. A. Daly (Northern Pacific), President


J. W. Dodge (Illinois Central), Vice-President


P. E. Bast (Delaware & Hudson), Vice-President

For example, take the mechanical department. Is your design of a locomotive such as to bring about the most economical use of fuel? I don't know much about back pressure, but I do know something about an automobile. I know when I have carbon in the cylinder I burn more gas, create less power and bring about more dissatisfaction than is the case if I don't. Isn't back pressure something like the carbon in your cylinder? Are your exhaust ports, exhaust passages and exhaust nozzles properly designed? In other words, when your steam has done the work is the freest possible outlet given it to the atmosphere? The cut-off and the speed also have something to do with back pressure. In Europe, I understand, they think this is so important that on a good many of the railroads they have a gage in the cab that shows just what the back pressure is. It adds to the effective manipulation of the locomotive to get rid of the steam when used, promptly and without delay

and if the necessary steps can be taken to save any of the back pressure incidentally it is reflected in reduction of fuel used. I simply cite this to indicate the importance of this question of back pressure, not with the idea of even suggesting putting gages on locomotives, but to indicate that investigation and care on the part of everybody in avoiding back pressure may bring about a decided improvement.

Take the operating department. I just read a paper by W. L. Richards, an engineman of the Union Pacific, on the advantages of pre-classification. That's its long name. What it really means is switching orders or switching shipping tickets instead of cars, and holding cars when necessary to avoid extra switching and in some cases, movement to destination in train lots. This item alone will save you a pound of coal and more in switching service.

How about standby time at engine terminals? I have just read a statement in the March number of the Engineers' Journal that steam locomotives burn some 29,000,000 tons of fuel while they are out of action—standing by in yards or roundhouses waiting to be put to work. What about it? Whether the amount is over-stated or not, is there not some opportunity for economy?

Improved locomotive terminals are more than mere mechanical contrivances offering means for reducing the cost of handling locomotives at the end of their run and conditioning them for the next run. They are operating features. Every hour that you can save for a locomotive at a terminal is that much to the good, not only in the actual saving of coal but in the use made of the locomotive investment. I will venture the assertion that in this one item alone you can pick up a part of that pound of coal I referred to. I don't know of any subject that will be more productive of useful information than a close check of means and methods, particularly the latter, to bring about a more intensive use of locomotive investment. This goes into everything—into the management of ash pits, shaking of grates, etc.—and the desire on the part of everybody and every department to keep this locomotive moving, because when the locomotive is standing still it is not only the investment in the locomotive but a lot of other investments that are non-productive.

You have had in the past years papers without number from scientific bodies, from our great universities, from technical and practical experts, and the latest development was a series of most excellent papers brought out by a competition inaugurated by your association, and in those papers practically every phase of this fuel subject has been covered. It would be useless for me to stand up here this morning and tell you of the things that have been written, and which you have read, on all these various matters. Just get out of your head that it is a big problem—it isn't; just get out of your head that it is wholly a scientific, technical problem—it isn't; all the science and technique in the world is powerless alone and without back of it the determination to do the job right; just get out of your head that it is Bill Jones' problem—it isn't. It is your problem. Just get into your head that in this pound of coal, and in your personal relation to it, lies the answer to the question.

Fuel Losses at Locomotive Terminals

This paper, by W. A. Kline, general road foreman of engines, Central of Georgia, contained constructive suggestions for the saving of fuel. The author considered with great thoroughness the possibilities of fuel economy by proper cinder pit operation, cleaning flues, washing boilers, loading tenders, lubrication, applying stack covers, building fires, etc. He pointed out that thermic syphons assist in the prevention of terminal fuel losses due to the increased area of firebox evaporative surface enabling locomotives to be fired up more quickly.

Increased circulation also tends to promote this end and adds to the durability of the boiler by the prevention of excessive expansion and contraction stress.

Regarding fuel economy meetings on the Central of Georgia, Mr. Kline said: "We have found that our monthly fuel meetings, presided over by the superintendent of terminals or division superintendent are of great value in bringing to our attention any condition that will reflect on the economical operation of locomotives. At these meetings the men themselves act as a committee of the whole and they are invited to make constructive criticisms of the power and any conditions causing fuel losses.

"These meetings are very interesting and are well attended. The master mechanic and his staff is present, listening to the complaints of the men and making notes concerning the conditions as outlined by those present. The questions discussed at these meetings meet with prompt handling.

"The men who blow flues, the fire-up men, the boiler inspectors and clinker pit men are present to give and receive suggestions concerning terminal losses. At these meetings fuel economy is discussed from every angle and the suggestions received from the men are of great value. The minutes of these meetings are published and made available for every man on the system.

"Fuel meetings as we hold them promote a fine, healthy family spirit, bringing the men and management closer together, bringing about team-work and co-operation. The meetings teach our men and officers to give thoughtful consideration to each other's rights. They bring about better understanding and appreciation of each other's viewpoint. They have improved the high quality of the service which the railroad endeavors to render."

In addition, Mr. Kline's paper makes definite recommendations regarding the most desirable scoop sizes and methods of handling coal.

Discussion

Several members referred to the saving in coal which may be effected by banking the fires of locomotives held over night at outlying terminals. B. J. Feeny, Illinois Central, advocated this practice, and then cleaning the fire two or three hours before the time for the locomotive to leave the terminal in the morning. This leaves nothing but dead ashes next to the grate to be dumped, with a good bed of live coke which may be spread over the grate after the fire is cleaned. If the fire were cleaned immediately on the arrival of the locomotive, it was estimated that from 1,000 to 1,500 lb. of good fuel would go through the grate into the ash pit.

On the St. Louis-San Francisco, at outlying points handling from three to eight locomotives, the fires are never knocked during the week, but are banked every night and then knocked out on Sundays. At larger terminals, it has been the practice to cover the grates with paper through which holes have been bored in the roll, before laying new fires. This prevents the loss of a considerable quantity of fine coal through the grates, the holes providing for sufficient draft to start the fire.

On the Denver & Rio Grande, W. J. Tapp stated that it is regular practice to make some one man responsible at every terminal for the carrying out of firing-up instructions and to see that new men hired for this work are thoroughly instructed in the standard practices.

L. G. Plant, National Boiler Washing Company, emphasized the importance of studying all of the possibilities for saving fuel at terminals inasmuch as approximately 25 per cent of all locomotive coal is consumed at terminals. He stated that 100 boiler horsepower, operating two hours, is required to fire up a locomotive, and that best practice requires 30 boiler horsepower for from one to one and one-half hours, and suggested the possibility of conserving part of this by direct application of steam to the locomotive boiler, rather than through the blower. The use of soot blowers, which

may be operated while a locomotive is in service, was also pointed out as a possible means of effecting considerable saving in terminal fuel consumption because it makes unnecessary the dumping of fires in order to clean tubes between washout periods.

Report of Committee on Fuel Stations

The American Railway Association's committee on design of shops and engine terminals at the 1923 convention of the Mechanical Division in reporting on the consolidated terminal plan had the following to say about coaling stations:

"Coaling stations may be of modern mechanical type or the older gravity tipple, the type selected usually depends on the number of engines handled, the number of tracks available for coaling engines and the kind of coal used.

"Station capacity should be at least 24 hours' or better still 48 hours' supply for maximum demand. The storage bins should be made self-cleaning as far as possible by proper sloping of floors. Gravity tipple outlet fixtures may be of the under cut or over cut type, preference is shown for the over cut gate as it seems to provide more even mixing of coal delivered.

"Mechanical coaling stations should be of the transverse type and a station serving several tracks is preferable to the longitudinal type because it facilitates engine movement to and from the station."

The committee suggests that an analysis be made of the feasibility of the plan for using a traveling crane and clam shell, with overhead storage limited to 360 tons as compared to mechanical type chutes where the overhead storage capacity is at least 100 per cent more than the daily issue of coal to locomotives. It has often been the case that a sufficient amount of overhead storage took care of the coaling of locomotives without delay during an emergency caused by a breakdown to the machinery.

One of the more recent methods of auxiliary ground storage adjacent to coaling stations was developed in the dragline and scraper plan, by which the coal is elevated from the track hopper to the top of coal chute building and dumped through a long spout to a point on the storage plot where it is available for handling with the scraper. This method of handling midwest bituminous and western lignite coals is not exactly what is desired. The handling movements are too violent and cause excess breakage and slacking of this friable coal, whereas this same effect would not be much in evidence in handling the harder variety of coal produced in the eastern and southeastern part of the United States.

One of the most important essentials in the use of mine run coal is to deliver it onto locomotive tenders in even mixture of the coarse and fine particles, by which means a more uniform firing efficiency is possible. Most of our storage bins are hoppered to one side and have entirely too much plan area permitting the coarse coal to roll to the outer edge and the slack or fines to settle in the middle or under the point of discharge when filling the bin. It is a common thing to find that the grade will differ on each one of a group of locomotives coaled from such a station. As a corrective plan, the consideration of bins not to exceed 10 ft. in diameter and hoppered to a central outlet is suggested. Added capacity can be obtained by increased heights or additional bins.

Operating stoker and hand fired locomotives out of a terminal requires fairly close sizing of the coal to each class of engine if fuel conservation is to be maintained. Two general methods may be taken to accomplish this sizing, viz: Coal may be sized at the mines and hoisted separately into assigned pockets in the coaling station; or coal may be received as mine run, reduced to 6 in. and under through breaker bars on the track hopper or passed through a crusher and then sized by passing the reduced coal over a screen. The separate products are discharged to different pockets.

Shaker screens, similar to those in use at the mines have been used, but the additional machinery and rigid structure required for their installation, together with the possibility of a shut down due to failure, favors the selection of a rigid bar screen.

The coal issue to stoker and hand fired locomotives at the Clinton, Illinois, terminal of the Illinois Central is divided about 50-50. The coaling station is of concrete and the storage pocket is divided in two by a concrete partition perpendicular to the coaling tracks. The roof and hoisting tower is of structural steel. The latter detail facilitated the alterations, for had the entire structure been made of concrete, the scheme would have had to be changed.

In order to maintain the original storage capacity of the overhead pockets, the hoisting tower was increased in height 9 ft. 6 in. and the dumping point of the buckets raised a corresponding amount. A timber partition was framed between the concrete partition and the end walls of the bin, thus dividing the bin into four pockets. The coal is discharged over the bar screen, the oversize being discharged to either the two right hand pockets and the undersize to either of the two left hand chutes equipped with gates.

The bar screen is 8 ft. long and 12 ft. wide, inclined at 30 deg., the bars are of 1½-in. square steel stock set on edge, making it what is commonly known as a diamond bar screen. The lower end of each bar is bent at right angles and rests in holes in the lower dead plate. The bars are spaced 4½ in. centers, thus making a clear space between the bars of 2½ in., the resulting product being about 6 in. by 3 in. oversize and 3 in. undersize. It was found that this spacing delivered 47 per cent to the hand fired pockets and 53 per cent to the stoker fired pockets. This preparation is close enough for all practical purposes, as a variation of the amount of coal issued to the two classes of engines would cause the quantity of the oversize to accumulate faster than the other and vice versa, so that it was necessary at times to veil a portion of the bar screen to increase the amount of hand fired coal and at other occasions some of the bars were removed to increase the quantity of the stoker fired coal.

This report was submitted by the following committee: L. J. Joffray (I. C.), Chairman; E. E. Barrett (Roberts and Schaefer Company), G. F. Bledsoe (Ogle Construction Company), W. S. Burnett, J. C. Flanagan (Fairbanks, Morse and Company), J. W. Hardy, W. T. Krausch (C. B. & Q.), A. A. Meister (S. P.), Frank Rasmussen, H. D. Savage (Combustion Engineering Corporation), T. W. Snow (T. W. Snow Construction Company) and E. J. Summers (C. M. & St. P.).

Discussion

Reference was made to an electrically operated device for coaling locomotives at small points where only a few locomotives are handled daily. The equipment includes a pit into which the coal is dumped directly from cars of the self-cleaning type, and then handled from the pit direct to the locomotive tender. In case coal is received in flat bottom cars, it can be handled direct from the car to the tender. In the case of the installation described, the coaling facilities are located some distance from the ash pit so that the coal and ashes have to be handled separately.

The importance of dividing large bins up into smaller bins was also emphasized as a means of preventing a too extensive separation of the fines and lump into different parts of the bin and causing a lack of uniformity in the coal delivered to the locomotives. In this connection, it was also suggested that mine operators be induced to provide loading aprons which put the coal into the car lengthwise and thus avoid accumulating all of the slack on one side of the car, as is the case when the coal is shot into the car transversely.

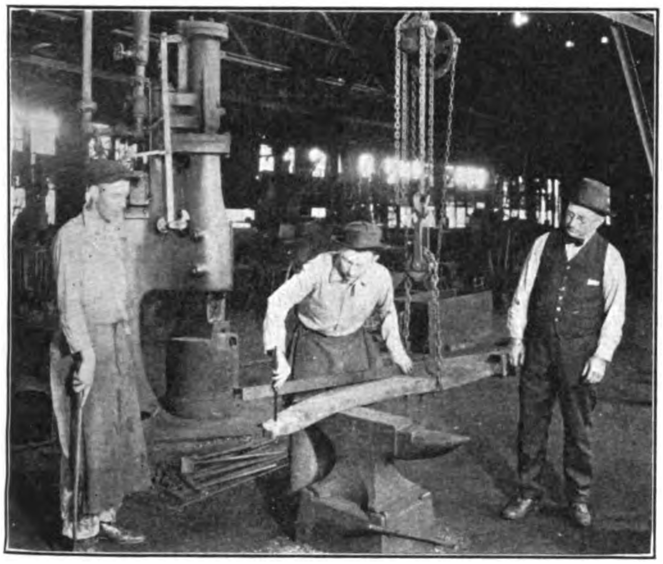
[Abstracts of other papers and reports will appear in next month's issue.—EDITOR.]

Apprenticeship Methods on the Santa Fe*

Thorough and Adequate Training in the Shop Is Insured by Having Special Shop Instructors

Part II

THE fault with many systems of apprentice training has been the neglect of shop training. Many railroads and industrial plants have established apprentice schools wherein the apprentices were taught drawing, mathematics, and other subjects, all of which were good so far as they went, yet the scheme failed because the young apprentice boy was left to the mercy of a very busy, overworked foreman who was being pushed for immediate shop output and had little or no time to devote to the green, inexperienced boy, nor to the training of those older in service. Oftentimes the helpless apprentice was kept on some one job for a year or more, coming out of his time a one- or two-job mechanic. Under such conditions it is no wonder the scheme failed. The apprentice was neither developed into a skilled all-around mechanic nor made efficient even on the work to which he was assigned.



Apprentices and Instructor in the Blacksmith Shop

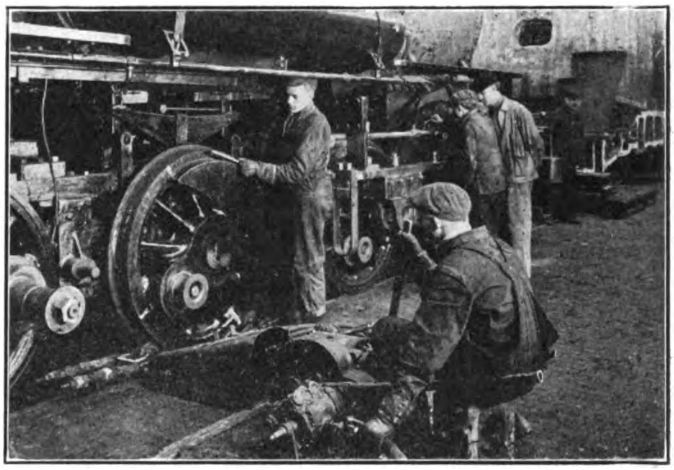
Foreman Too Busy to Instruct Apprentices

The old way of placing a new boy in the tool room to hand out tools, or with a mechanic under the guise of a helper, or putting him to sweeping the floor, or to cleaning up machines, has no place under modern methods of apprentice training. The apprentice must be made to produce, must make things to be used, so he can go home with a heart full of joy and tell his father or mother, "I made a bolt for Engine 976 today, all by myself."

The foreman in a modern railway shop has too many other duties and is too hard pushed for immediate output, to be expected to give to the inexperienced, untrained apprentices the instruction and painstaking attention needed to develop them into skilled all-around mechanics. He must cooperate, but the responsibility for this training must be placed upon someone with no other duties to perform. Neither must the men upon whom the responsibility for this training is placed be given charge of too many apprentices. Just as certain training systems have failed on account of confining the instruction to that given in the school rooms, so have other systems failed which provided only one apprentice shop instructor regardless of the size of the shop or the number of apprentices in his charge.

A Shop Instructor for Every 20 Apprentices

No phase of the plan of training given apprentices on the Santa Fe has given such immediate or permanent results as that resulting from the shop instruction of apprentices. An apprentice shop instructor has been assigned for each department, or one for about every 20 or 25 apprentices. This instructor has no other duties than those relating to training the hands, the eyes and the judgment of the apprentices in his charge. He is not responsible for the output of the shop or the output of any machine but is assigned to his duties solely for the purpose of seeing that the apprentices learn quickly and are taught the most improved and modern methods of operation. Increased immediate output of the shop is one of the results of his work but this is considered of far less importance than the ultimate development of skilled mechanics.



Instructing Apprentices in Setting Valves

Each shop instructor must be a boy-loving man, a first-class mechanic of his trade, patient and active and above all, capable of inducting some of his knowledge into the boy—one who not only knows but knows how to tell what he knows. He takes the boy in hand, and if a machinist apprentice, starts him out on some simple machine, first showing him the different parts of the machine, how it is controlled and operated, what safety precautions to take in order that his fingers, arms, or body may not be endangered, also to be on the lookout at all times for the safety of his fellow workmen. He teaches the apprentices the function of each machine, the necessity for taking proper care of machines, how work should be placed, how tools should be ground and set, what speed and feed to use, proper methods of bench and floor work, the assembly of parts, the relation of one part to another, the whys and wherefores of performance of

*This is the second of a series of articles descriptive of the apprenticeship system of Atchison, Topeka & Santa Fe. The first one, appeared in the June issue. The next article will be devoted to the instruction given apprentices in the shop schools.

these parts; in fact, everything they may need to know in connection with the work assigned them.

He encourages them to ask questions and by precept and example inspires them to take full advantage of the opportunities offered. There are apprentice shop instructors not only in the machine shop, but also in the boiler shop, the blacksmith shop, the paint shop, the cabinet shop, and in the freight car shop.

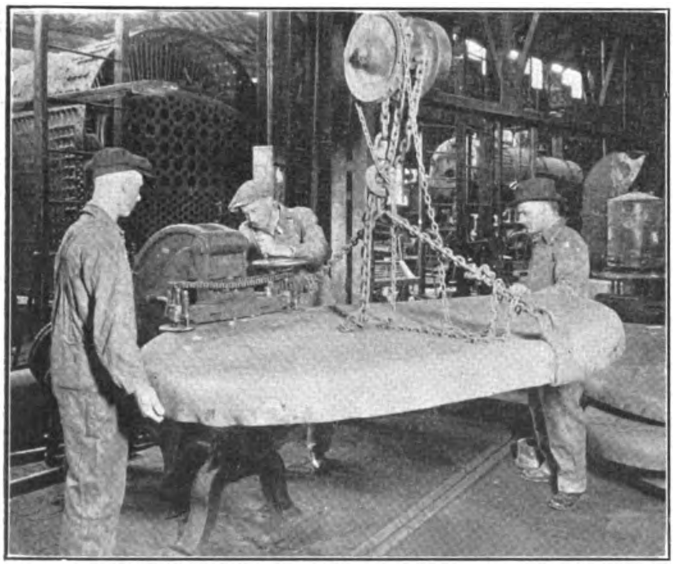
Shop Instructors Responsible for Changing Apprentices

It is the shop instructor's duty to see that each apprentice is moved from machine to machine, from one class of work to another, from machine to floor, from floor to bench, etc. Foremen and instructors work in harmony, without friction and with the fullest co-operation. The foreman is responsible for the output of the shop, the instructor for the instruction and training each apprentice needs. The foreman may assign the work to the various machines, but the instructor knows which apprentice is best fitted for performing the work in question and which apprentice is in most need of the experience offered. He places the apprentices accordingly and is at hand to see that the work is properly performed.

Changes in machines or work assigned apprentices may be made at any time but in general are made on a certain date each month, the foreman and the apprentice usually being notified in advance of the changes about to be made. Knowing that he will be assigned next month to a certain coveted machine, the apprentice observes the work carefully and when so assigned can generally go ahead with little instruction.

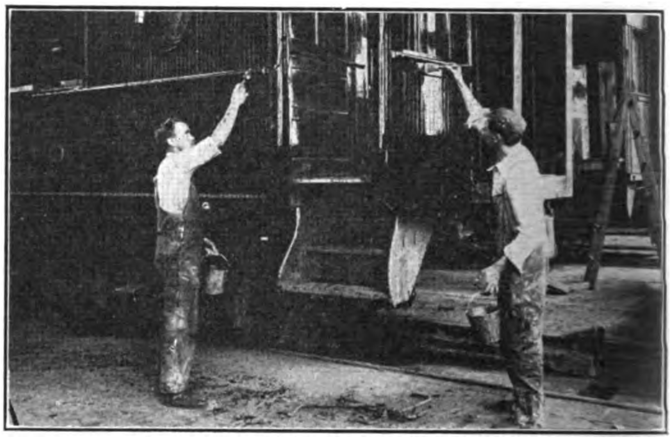
Definite Schedule of Shop Work

A definite schedule of shop work has been mapped out for apprentices of each trade, so as to insure each apprentice in that department having a fair and impartial show. These schedules show the different classes of work on which each apprentice must receive experience and the time allotted to each. They vary according to the opportunities offered at each shop. They are arranged according to the intricacies of the work so that the apprentice may gradually advance from the simple to the more difficult classes of work. The time allotted to each machine or class of work has been so equated that the apprentice may become reasonably efficient upon each.



Instructing Boilermaker Apprentices on Flange Work

This does not mean that he is necessarily kept on each job the full-allotted time without rotating. There are times when conditions will justify pulling him off one class of work and trying him out on another in order to give himself confidence, he being later returned for further experience on the work from which he was removed. Neither is it understood that the schedule must always be followed exactly in the order specified. It must be made sufficiently flexible to meet the exigencies of the shop but followed closely enough to prevent the apprentices being used merely as a matter of convenience. The instructor must see to it that at some time during the period of apprenticeship each apprentice is given experience on all the classes of work stipulated in the schedule for that trade. He must keep each boy busy, never allowing an apprentice to hunt him up for another job. He should have his work so laid out that the boy always has a job awaiting him. He has the authority and must change the boys from one class of work to another in accordance with the specified schedule. Failure to make these changes on scheduled time deprives the apprentice of full time on some subsequent job, and deprives some other boy of the full opportunity he should receive on this job.



Painter Apprentices Varnishing a Coach

Individual and Group Records Shows Actual Experience

A detailed record is kept of the shop work of each apprentice. This record, a copy of which is sent to the supervisor of apprentices each month, is made in loose leaf form, a separate sheet for each boy, and shows the number of days' experience on each class of work to which the apprentice is assigned, and the month and year in which this experience was given. It shows also the number of days off during the month, the total number of working days in the month being accounted for, so that there may be an accurate, indisputable record of just what experience is given each apprentice. This record also shows the quality of work done on each class of work—whether excellent, good, fair, medium or poor—thereby showing for which class of work the apprentice shows most fitness. This information is of value in determining to what class of work to assign the apprentice when he completes the course.

In addition to the individual shop record of each apprentice, further record is kept on a large sheet for each trade. This record shows at the top the schedule of work for apprentices of that trade at that particular shop and the time allotted to each class of work, and at the left the names of the apprentices of that trade and the hours served by each. The shop instructor enters in pencil on this sheet the number of days' experience given each apprentice on each class of work, making the necessary corrections or additions once each month so that it constantly shows at a glance the total experience each apprentice has thus far been given and the class of work still to be given him before graduation.

This record is of great assistance to the instructor in show-

ing at a glance how closely the experience actually given each apprentice conforms to that of the prescribed schedule. For instance, the instructor in the machine shop can see at a glance just what machines each apprentice has already had and to what machines and erecting work he must still be assigned before completing his apprenticeship. Incidentally this record shows supervising officers how faithfully the instructor is carrying out the instructions given him to see that each apprentice is given full variety of experience on all classes of work of his trade. If the instructor has been

Freight Car Rebuilt Exclusively by Apprentices, Showing the Instructor and Apprentices Who Did All of the Work, Including Carpenter and Steel Work, Trucks, Air Brake Work, Painting and Stenciling; the Actual Man-Hours Were Less Than the Average for Full Rated Carmen

negligent, this record will show it. This record is also of great value when apprentices are desired for any particular class of work. For instance, if apprentices are desired for lathe work, or for milling machines, or any other work, this record shows just what apprentices are available and best fitted for, or most in need of this particular class of work.

Thorough Experience Guaranteed

Space does not permit showing all these schedules for the various trades and shops, but representative samples are shown in the illustrations. The schedule shown for the machinist trade is one adopted for one of the larger shops. Note the wide range of work on which each apprentice is given experience, and that apprentices from these larger shops are given six months' roundhouse experience. Apprentices from the small roundhouse points are likewise transferred to one of the large shops for back shop experience. Similar transfers are made with boilermaker and sheet-metal worker apprentices.

Note from the schedule of work prescribed for boilermaker apprentices the varied classes of work offered. Few boiler makers in the land received such a wide range of experience. Blacksmith apprentices receive experience on light fire, medium fire, and heavy fire, spring work, heating and helping at the steam hammer forge, operating light forge machinery, operating steam hammer, autogenous welding, etc. The schedule for sheet-metal worker apprentices includes experience in tin shop, babbitt shop, freight car shop, on jacket work, locomotive pipe work, passenger car work, water service work, brazing, welding and roundhouse work.

SHOP SCHEDULE FOR FREIGHT-CARMAN APPRENTICES AT TOPEKA, KANS.

General Car Body Work	Months
Wood body work Safety appliance Side and end doors Underframe Draft gears	14½
Oiling and packing	½
Trucks and wheels	4
General steel work	4
Inspection	1
Total	24
Air Brakes	
Cylinder cleaning	1
Triple valves	1
Pipe work	2
Testing	2
Total	6
Mill Work	
Saws Planer and gainer Mortiser and boring Layout	6
Miscellaneous welding, etc.	..
Grand total	36

Painter apprentices are given outside and inside body work, experience in spraying, in locomotive painting, in stock room, in lettering, stenciling and sign painting. The schedule shown for freight carman apprentices shows the thoroughness of the shop training given this class of apprentices. Certainly the graduate of any of these courses should be an all-around mechanic.

SHOP SCHEDULE FOR BOILERMAKER APPRENTICES AT LA JUNTA, COLO.

Back Shop	Months
Heating rivets	½
Light sheet iron, cabs, running boards	3
Tanks	2½
Ash pans	2½
Front ends	2½
Staybolts, radial tate, flex. exp. bolts	4
Autogenous welding	4
Flues, arch tubes, flue shop	4
Sketching and special work	1
New fireboxes	2
Flanging and layout	4
Patches	4
Firebox sheets	4
Flue sheets and braces	4
Total	42
Roundhouse	
Grates and hot work	2
Ash pans, front ends	1
Electric arc flue welding	1
Staybolts, radials, flues	1
Inspecting and testing staybolts	1
Grand total	48

SHOP SCHEDULE MACHINIST APPRENTICES
ALBUQUERQUE

MACHINE SIDE

Name	Card Number	Hours of Service	Drill Press	Nut Facer	Cold Saw	Bolt Lathe #1	Bolt Lathe #2	Bolt Lathe #3	Link Lathe	Rod Lathe	24" Air Room Lathe	30" Engine Lathe	Valve Bushing Lathe	Link Shaper	Rod Shaper	Small Slotter	Large Slotter	Milling Machine	Boring Mill	Horizontal Boring Mill	Planer	Turret Lathe		
	Months →		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1		
Bryce, C.W.	1284	3931				20	13	27	35	39	29	23	33	14	27	45	42		25	32	23			
Binkert, M.	1256	9027		13		26	25	25	36	28	25	35	25	34	34	33	36	24	37	25	30			
Buday, V.	1248	8726[4]	24	8	21	34	35	35	28	27	26	23	26	25	26				24	23	63	20		
DoBell, F.	1283	2293[2]	41	27	13						27					30	31							
Foster, B.W.	1268	2288[6]	26			21	20							26	23					1				

ERECTING FLOOR

Name	Rod Bench	Link & Valve Bench	Driving Boxes	Cylinders & Frames	Cab Job	Guides & Pistons	Rocker Box Bench	Steam Pipes	Spring Rigging	Brake Rigging	Misc Floor Work	Air Room	Shoes & Wedges	Valve Setting	Lay Out Bench	Inspecting	Round House	Autogenous Welding	Tires & Wheels	With Finishing Foreman		
Months →	1	1	1	1	1	1	1	½	½	½	1	2	2	2	1	½	6	2	1	1		
Bryce, C.W.				10	25										25			4				
Binkert, M.	29	6	26	19	21	23			30		76		71	21	20		85	31				
Buday, V.	24			35	42	27		21			98	38	79	60			157	40				
DoBell, F.	25			24		24			13	11	17		13	36								
Foster, B.W.	2		13	22	30	45					30		25									

Shop Schedule for Machinist Apprentices at a Large Shop—The Records Shown Are Actual Cases Selected at Random

Space does not permit a detailed account of the sequence

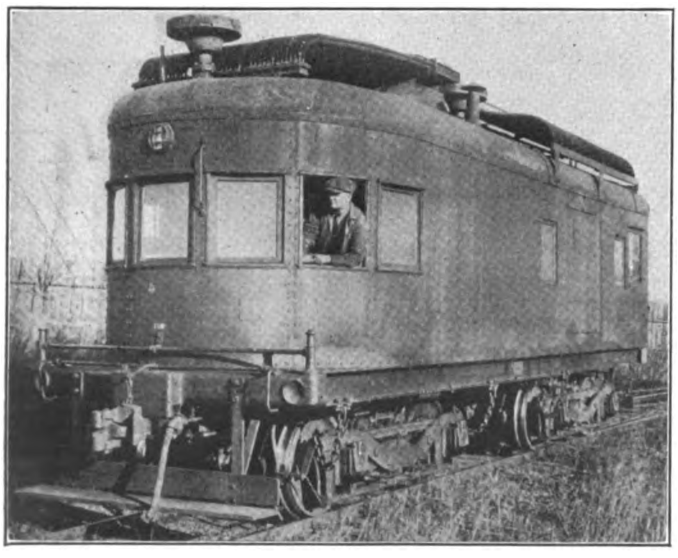
of training given apprentices of the different trades. Suffice it to say that for the machinist trade it has been found preferable to start the apprentice on machines and end up on the floor. Machine work is more interesting than floor work to a young boy. Moreover when starting his apprenticeship the boy is young and soft, and often unequal to the heavy floor work which a modern locomotive requires. During his first six months, or probationary period, the apprentice should have experience on three or four different machines, as it should be incumbent upon everyone having anything to do with his training to determine during this period whether he has sufficient talent for development and is capable of mastering the trade. He must be kept interested, for at 16 he is restless and not accustomed to the daily grind or to the monotony of doing the same thing hour after hour, day after day. He is in the shop to learn a trade and must have a fair chance—a boy's chance. His ambition should not be killed.

Results of Shop Training

The apprentice should never be used as a matter of convenience. His development into a skilled mechanic is paramount to the immediate work performed. He is indentured to learn a trade and this feature should not be lost sight of in the desire for a large output from the shop. The apprentice on the Santa Fe is given an opportunity, the best that can be given anywhere. The purpose for which the apprentice is employed—the making of skilled mechanics for the shops and roundhouses—is ever borne in mind. Needless to say, the additional work performed by these apprentices because of the instruction and training given them, more than offsets the cost of their training. The more than 16 years' experience on the Santa Fe has shown that the cost of the shop instructors' salary should not be considered an expense but rather as an investment from which inestimable returns have already been received.

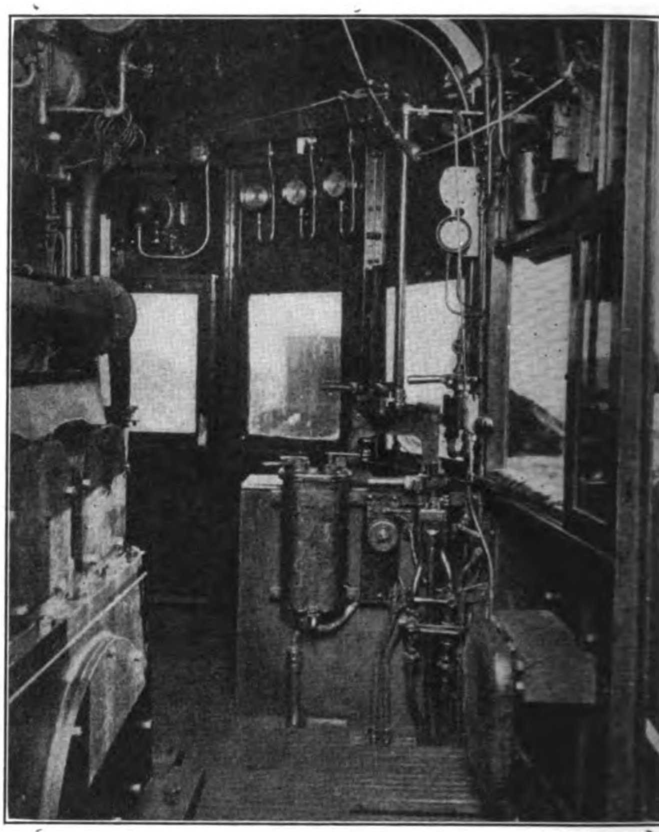
Oil-Electric Locomotive with Injection Type Engine

An electric locomotive, driven by a fuel-oil engine, the first of its kind built in America, has been built jointly by the General Electric Company and the Ingersoll-Rand Company. This has been especially designed for switching service and is receiving its first practical test by the New York Central in its freight yards on the west side, New York City.



Front End View of the Oil-Electric Locomotive Built Jointly by the General Electric Company and Ingersoll-Rand Company

The power plant equipment consists of a 300-hp. oil engine, manufactured by the Ingersoll-Rand Company, directly connected to a 200-kw. General Electric generator. The direct motive power consists of four HM-840 General Electric motors, one of which is geared to each of the four axles.



Interior of the Cab, Showing the Throttle and Controller—the Oil Engine is at the Left

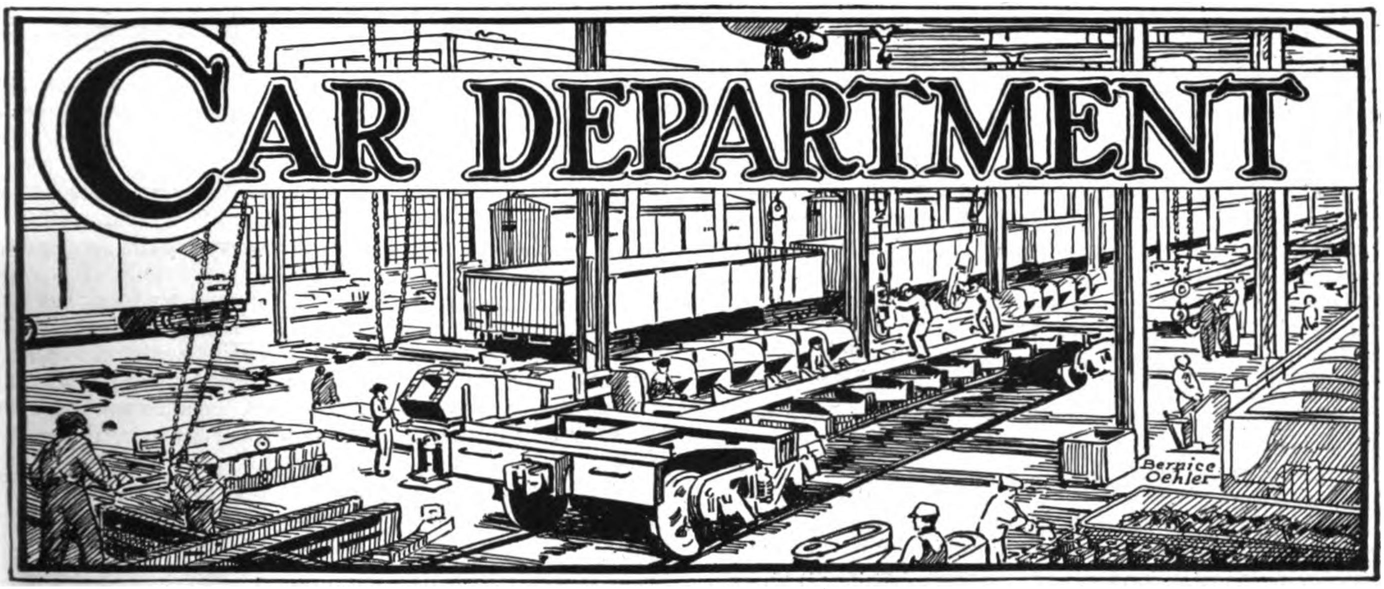
The locomotive has a total weight on the drivers of 60 tons.

The six-cylinder engine is designed to burn fuel oil according to the principles of the well-known Price system of direct fuel injection. This system avoids the use of high pressure injection and also effects a reduction in weight, an improvement in mechanical efficiency and increased simplicity and reliability. The fuel is injected into the various cylinders through a distributor by a single acting plunger type pump.

All parts of the cylinders, cylinder heads and combustion chambers are water cooled. The water from the water jackets passes to a radiator located on the roof and a thermostat maintains an even temperature irrespective of weather conditions. The muffler for reducing the noise of the exhaust is also mounted on the roof. Sufficient fuel can be carried for 48 hours continuous switching service.

The engine consumes about 0.43 lb. of fuel oil per brake horsepower. Owing to its high economy it is free from smoke, which renders it particularly suitable for service in cities or in places where smoke is objectionable. As ordinarily used in switching service, the locomotive has consumed about 20 to 26 cents worth of fuel oil per hour.

The unusual feature of the design of this locomotive is the use of a direct current generator supplying current to the motors without intervening accelerating resistances. This is accomplished by using a differential series field on the exciter, which automatically reduces the generator voltage with the increase in the amount of current drawn by the motors. The speed, therefore, automatically increases as the load is reduced, corresponding to the rise in impressed voltage.



Unit System for Freight Car Repairs

Fixed Applied Piecework Labor Costs Per Car Used as the Basis of Output

By J. McClennan
General Shop Inspector, New York Central, Buffalo, N. Y.

THE opportunity for railroad executives to compare the performance of their large and small repair plants, representing millions of investment, rests largely upon the manner in which their mechanical department heads arrange to report output. Inquiry has failed to disclose the existence of any reporting method other than the light, medium and heavy segregation, under which, for example, a light repair job is one consuming under 20 hours, a medium 20 to 50 hours and a heavy job 50 hours and over, unaccompanied by any supporting unit output basis to eliminate those spreads which induce inaccuracies of comparison. The majority of the roads operate on a piece work basis or some adaptation thereof and establish money limits for each of the above classifications, based on about 63 cents an hour. The range of heavy freight car work is so wide that proper comparisons with previous performance are impossible under the existing classification.

The light, medium and heavy segregation is not sufficiently illuminating because it restricts to three classes important work which should be reported under at least eight, and it lacks a proper summary by units. The reporting of repairs on the basis of expended hours is erroneous because the hour

REPORT OF FREIGHT CARS REPAIRED

MONTH__________ 19____ SHOP________________

DIVISION____________ DEPT. HEAD________________

Class	Class No. 1		Class No. 2		Class No. 3		Class No. 4		Class No. 5		Class No. 6		Class No. 7		Class No. 8	
Hours	Under 20		20-50		50-80		80-110		110-140		140-170		170-200		200 & up	
Applied P.W. cost	Under $12.60		$12.60-$31.50		$31.50-$50.40		$50.40-$69.30		$69.30-$88.20		$88.20-$107.10		$107.10-$126.00		$126 & up	
Ratio each class to all	.01		.04		.07		.10		.14		.18		.20		.25	
	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost	Car No.	App. P.W. cost
1.																
2.																
3.																
4.																
5.																
6.																
7.																
8.																
9.																
10.																
Total cars and cost																
Total same mo. lt. yr.																
Total last mo.																

Summary	This Year	Last Year	Last Month
A. App. P.W. cost—grand total of above	*		*
B. Output units $\left(A \times \frac{1}{.63}\right)$			
C. Man hours applied labor			
D. Output units per man hour $\frac{B}{C}$			
E. Ave. P.W. hourly rate			

* If schedules were advanced 5 per cent since last year the applied P.W. cost should be divided by 105 per cent.

A Proposed Form for Reporting Freight Car Repair Output for Comparison by the Piece Work Labor Cost System

is not indicative of output, and its use borders on the trial and error process, although it must be resorted to at shops working on a day basis. The use of money limits without equating them for each general advance or reduction in labor costs destroys the comparison of output with previous years.

The ideal output unit is probably the labor and material cost of repairs per pound. Railroad executives know they can buy new locomotives for about 16 cents a pound, steel coaches for about 18 cents a pound, steel box cars for 6 cents a pound, steel hoppers for 5.5 cents a pound, etc., but it is apparent that the accounting cost of reporting freight car repairs on a pound basis would be prohibitive.

The managements will always insist on reports showing the number of cars repaired, but they are entitled to a comprehensive report along these lines which will more accurately reflect the true conditions.

Piece Work as a Basis of Output

It is suggested that fixed applied piecework labor costs per car be used as the basis of output, as they represent accurate indices of work accomplished. These applied piecework costs are usually uniform at all shops on a given road, and the information is available at every shop and repair branch for payroll purposes immediately upon completion of the car, and would therefore not involve additional expense for the purpose of the output report.

Piecework unapplied labor costs incidental to each car receiving repairs such as milling the lumber, manufacturing the forgings and fabricating the steel should not be considered, as the fabricating machinery, and consequently the piecework costs of such unapplied work, would vary at all shops, thus destroying one of the main purposes of the proposed output report which is to compare output of one shop with another. The motor horsepower determines the cubic inches of given metals which can be removed per minute on lathes, shapers, millers, drills, slotters, etc., when using the same grade of high speed steel in cutting tools, but the setting up time is a variable which would negative a miscellaneous output comparison on machine work. Furthermore the unapplied or machine labor is only about 15 per cent of the applied labor.

Proposed Car Repair Form

The report blank illustrated would in the writer's opinion furnish data entirely acceptable to executives desiring a continuation of output reports which are based on the number of cars put through each large and small shop. It provides in lines *A* to *E* a real output unit comparison. The ratio of each class to all classes is shown for statistical purposes.

The rate used to produce the applied piecework labor cost is .63 cents an hour, the predominant rate for wood and steel freight car repairers today. If in the future it should be advanced about 5 per cent on a given road, or to 66 cents, the columnar headings on these reports with respect to applied piecework cost should be changed to represent 95 per cent of those shown so as to perpetuate the unit comparison, as 5 per cent more money then spent on the unit would not indicate 5 per cent more work than formerly.

The basis of the output unit comparison shown in lines *A* to *E* is nothing more than a constructed unvarying piecework hour, properly equated to maintain comparisons. This piecework hour is the proper unit of output. It is involved, or becomes a matter of record, only when work or output is achieved. It is not and should not be the straight piecework hour.

When consolidating for a division or road the reports as outlined, it may occasionally happen that piecework schedules of shop *A* are 10 per cent higher than point *B*. If so the point *B* applied piecework cost (line *A*) should be divided by 110 per cent to effect proper comparison of output units per man hour at both points.

The use of this form modified to suit the conditions on each road would develop the following facts:

First—It would provide an accurate basis of comparison one month with another at the same shop, and one shop with another in same month, irrespective of the nature of the work, size of plant, force, etc.

Second—It would effect an accurate comparison for years, irrespective of changes in the character of repairs.

Third—It would indicate whether heavy repairs in general were increasing at a given point.

Fourth—It would eliminate the present tendency to assume that mismanagement exists when there is a decrease in the number of cars receiving heavy repairs, with perhaps an increase in the payroll, during any current months as compared with the previous month, when as a matter of fact the heavy cars in the current month received more extensive repairs.

Fifth—It would perpetuate existing comparisons, as it merely amplifies, without discarding, the present segregations as to light, medium and heavy repairs.

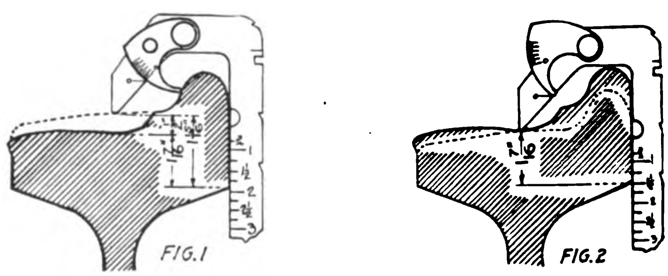
A New Use for the A. R. A. Steel Wheel Gage

By A. B. Crandall

Chief Mechanical Draftsman, Akron, Canton & Youngstown, Akron, O.

THE new A. R. A. steel wheel gage is designed to give data in connection with the restoration of a normal tread contour to worn steel wheels. This data is required for A. R. A. billing purposes and for the machining of the tread. The application of the gage to sharp flanges has been fully covered in previous articles.*

This gage may be used to give the same information in the case of the double flange. An inspection of the illustrations suggests a method for this case. It is first desired to ascertain the amount of metal which will have to be removed to restore the normal tread. To determine this the adjustable finger of the gage is placed at zero and, when so adjusted, should fit



Method of Using the Steel Wheel Gage on Double Flanges

a normal tread. The adjustable finger should touch the flange, and the tread finger should touch the tread. Hence, if applied to a worn double flange tread, as shown in Fig. 1. the long graduated finger shows the thickness of the tread before turning.

The adjustable finger is then swung out of the way, and the gage is reapplied, as shown in Fig. 2. The long graduated finger now shows the thickness of the tread after turning. Hence the difference in the readings is the amount of metal which must be removed to restore the normal tread contour on the wheel.

For example, by placing the adjustable finger at zero, and applying as shown in Fig. 1, the graduated finger shows a tread thickness before turning, of 1 15/16 in. The adjust-

* See the *Railway Mechanical Engineer* for March, 1924, page 164, and April, 1924, page 224.

able finger is then swung out of the way and the gage applied as in Fig. 2. The reading on the graduated finger is now 1 7/16 in. The metal which must be removed to restore normal contour is the difference between the two or ½ in.

By this method it is possible to procure all necessary information for A. R. A. billing and for machining the tread. The basis for the above solution is that the flange surface of the worn tread is the original perfect flange and has not been subjected to wear. This is the actual case. The errors in truck alinement or other causes which bring about a double flange create a condition wherein the rail does not come in contact with the flange, but wears a groove some distance removed from the flange. Hence an inspection of a double flange shows tool marks on the flange surface, indicating that on such a type of worn tread the flange does not suffer wear, but retains its original true shape.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Rules Governing Prices Have Changed Before Repairs Are Completed

In November, 1920, the Terminal Railroad Association of St. Louis rendered a bill amounting to $841.48, vs. the Northern Pacific, for the cost of repairs to Northern Pacific car No. 100285. A letter was addressed to the car owners, dated September 2, 1920, accompanied by an inspection certificate, the first and main sheet of which bore no date, the second and third sheets of which bore date of August 24, 1920, with request that disposition be furnished under the provisions of Rule 120. Disposition was furnished by the car owner in a letter dated September 13, 1920, but the companies were not able to agree as to the proper estimate of the amount of repairs on the car. The Terminal Association claimed that the estimate of the cost of labor and material should be based on the date that the repairs to the car had been dated. The Northen Pacific contended that the cost should be based on the date that was shown on the first sheet of the second certificate.

The Arbitration Committee decided that in rendering a bill the prices in effect on the date repairs were completed should govern notwithstanding the estimated cost of repairs, as shown in the inspection certificate, was based on prices in effect on the date of inspection for reporting car under Rule 120. The car owner should properly assume the increased cost of repairs due to the increase in prices, with the $50.00 margin provided in Rule 120.—*Case No.* 1294, *Terminal Railroad Association of St. Louis vs. Northern Pacific.*

Overlapping Labor Charges

Under date of March 14, 1923, the Missouri, Kansas & Texas received from the Peerless Transit Line a bill amounting to $584.58, covering a number of repairs made to PTLX tank cars on authority of defect cards.

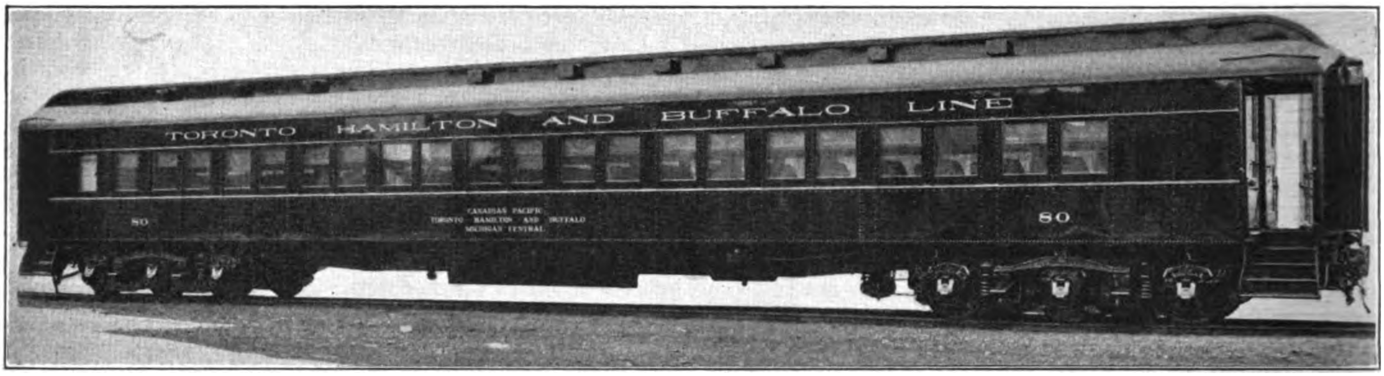
Upon making a check of this bill, exceptions were taken to charges for removing the brake shaft and uncoupling levers and replacing in connection with the renewal of the end running board on the "B" end of the car. The defect card, together with the billing repair cards on the cars in question were returned to the Peerless Transit Line with the request that it reduce the charges to conform with item 278-B of Rule 107, which provides for a charge of 11c. per foot for renewing the running board on tank cars, including all bolts, fitting and boring. The Peerless Transit Line refused to reduce its charge and the Missouri, Kansas & Texas contended that the labor for replacing the brake staff and release lever was not covered by the item referred to of Rule 107.

The Missouri, Kansas & Texas claimed that no charge should have been made for the removal and replacing of the brake shaft and uncoupling levers as this was necessary to apply the running board on either the A or B ends of the car. They, therefore, charged that such items were incorrect. The Peerless Transit Line contended that under the same rule, item 76 made it permissible to render the charge of 1 1/10 hours for the replacing of the brake staff, and in item 254, it allowed 8/10 of an hour for replacing the release lever, making a total charge of $2.09 for replacing the brake staff and release lever.

It was decided by the Arbitration Committee that no additional labor may be charged for removing and replacing the brake shaft and uncoupling lever on account of the renewal of the end running board on the same end. Specified average charge of 11c. per foot for renewing the running board on tank cars governs as per item 278-B of Rule 107.—*Case No.* 1293, *Missouri, Kansas & Texas vs. Peerless Transit Line.*

Incomplete Evidence Furnished to Support Claim for Wrong Repairs

On September 11, 1920, the Baltimore & Ohio made heavy repairs to the B end of Louisiana & Arkansas box car 2559. A bill of $663.33 was rendered by the Baltimore & Ohio to the car owners. The Louisiana & Arkansas questioned some of the charges contained in the repairing line's bill and asked them to cancel charges amounting to $22.67. The repair items questioned were for patching the body bolster. The owners claimed that the bolsters on this car were of cast steel construction and therefore the charge for patching was an error. The repairing line, however, refused to cancel these charges on the ground that the original record of the car showed that the bolster was of pressed steel construction and it contended that the Louisiana & Arkansas should secure a joint evidence certificate according to Rule 12. The car owners claimed that cast steeel body bolsters were standard to this equipment and that it had no record of cast steel body bolsters ever being applied to this car previous to the time of the Baltimore & Ohio's bill for repairs. It further contended that the patching of cast steel bolsters was considered temporary repairs. General repairs were made to this car on July 2, 1921 and new body bolsters were applied. However, a joint evidence was not obtained at this time as the car owners considered the work done by the Baltimore & Ohio to be a case of temporary repairs and not one of wrong repairs. The repairing line, however, claimed that the owner should have obtained evidence at the time general repairs were made and as its records show that the car was equipped with pressed steel body bolsters the matter was referred to the Arbitration Committee which rendered the following decision: "The car owner has not furnished the necessary evidence to establish a claim of wrong repairs. Therefore, the position of the Baltimore & Ohio is sustained. —*Case No.* 1297, *Louisville & Arkansas vs. Baltimore & Ohio.*

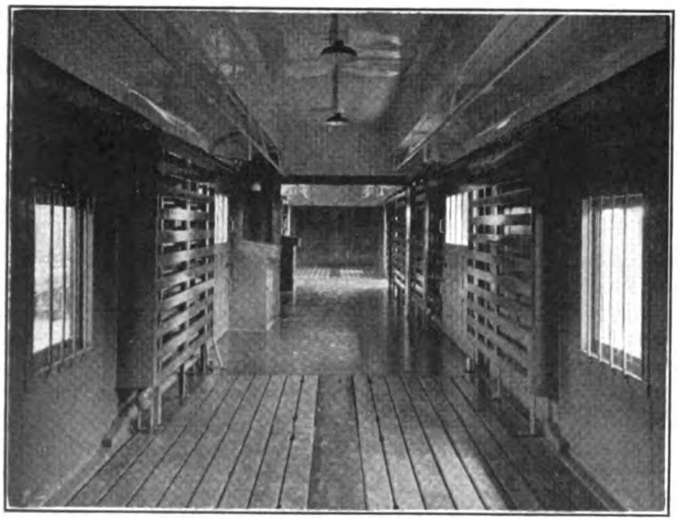


The Coaches Can Seat Eighty-seven People

New Passenger Equipment for the T. H. & B.

Coaches and Baggage Cars Are of Steel Construction and Are Equipped with Clasp Brakes

THE Canadian Car & Foundry Company, Limited, Montreal, Que., recently delivered to the Toronto, Hamilton & Buffalo 26 all-steel cars to be used in its passenger service between Toronto, Ont., and Buffalo, N. Y. This equipment consists of 10 first-class coaches, 10 smoking coaches and 6 baggage cars. The smoking coaches are of the same general construction and finish as the first-class coaches, with the exception of the upholstery of the seats. The first-class coaches are upholstered in plush, while the smoking coach seats are upholstered in leather. These cars have a seating capacity of 87 in the main room. Both the men's and women's saloons are equipped with single bowl wash basins and Duner exposed type hoppers. Water coolers are provided at each end of the car. The main room has basket racks for holding luggage and the smoking cars are also provided with match box holders and match strikers at every seat.



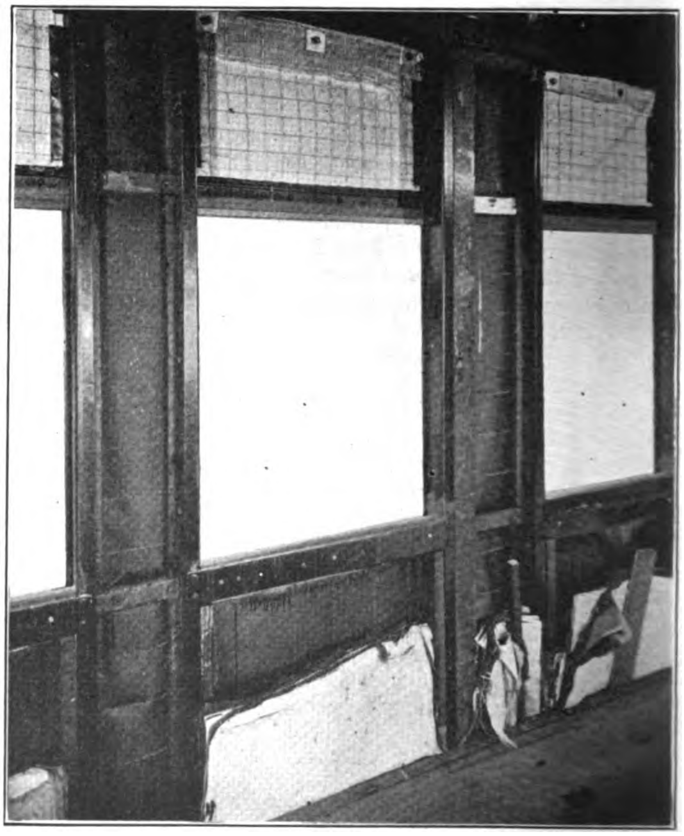
Movable Floor Racks Are Provided at the End Sections

Underframe Construction

The center sills are of the built-up fish belly type and have 5/16 in. web plates. The web plates are reinforced with one 6 in. by 4 in. by 5/8 in. top angle and two 3 in. by 3 in. by 3/8 in. bottom angle stiffeners. A 1/2 in. cover plate is connected to the side sills by 5/16 in. pressed web plates, reinforced with 3 in. by 2 1/2 in. by 5/16 in. angles. The side sills are made of 5 in. 11.6 lb. wrought steel Z-bars.

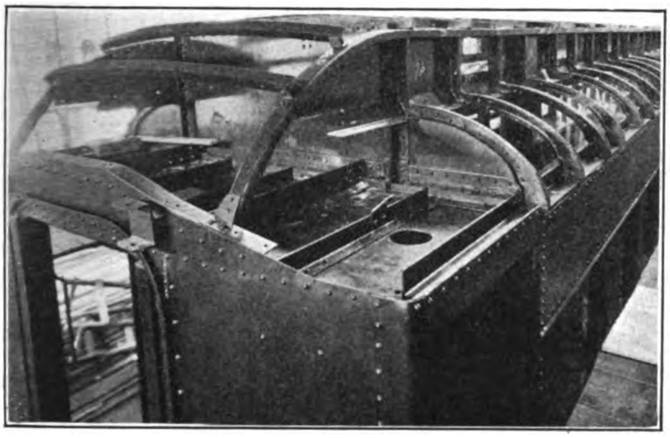
General Dimensions

The total length over the buffers of the passenger and smoking coaches is 84 ft. 4 1/2 in. The length over the end sills is 73 ft. 6 in., while the length inside of the main room is 72 ft. 10 in. The distance between truck centers is 57 ft. 6 in., and the trucks have a wheel base of 11 ft. The outside width over the eaves is 10 ft. 2 3/16 in., and the width



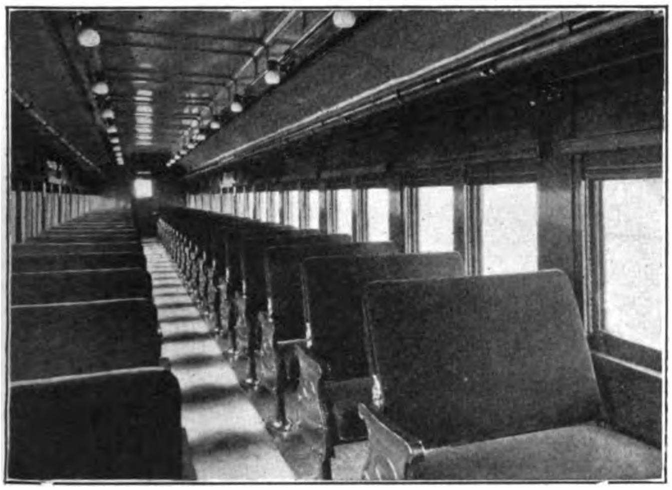
The Side Walls of the Passenger Coaches Are Well Insulated

over the side sills is 9 ft. 9 5/8 in. The inside width between the side posts is 9 ft. 1 in., which permits an inside clearance of 8 ft. 11 in. The height from the top of the rail to the



View Showing the Roof Construction

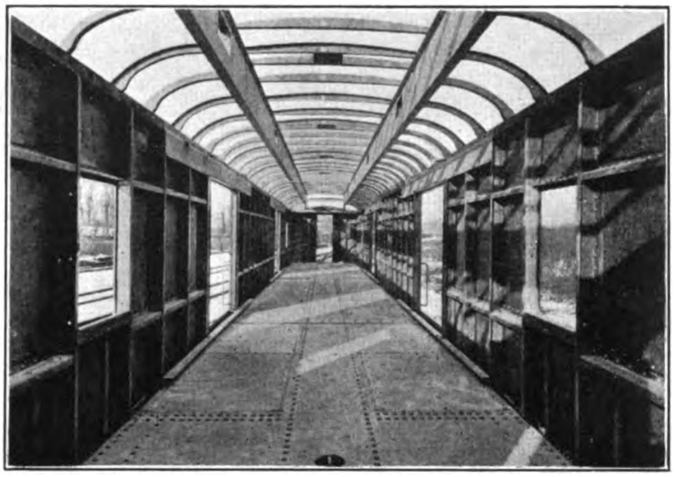
top of the roof is 14 ft. 1 1/2 in., and the height to the top of the platform of the passenger coach is 4 ft. 2 7/16 in. The empty weight of these cars is 150,600 lb.



The Ceiling Lights Are Staggered to Equalize the Illumination

The baggage cars are shorter than the passenger equipment, having a length over the buffers of 77 ft. 3 1/2 in. and a length over the end sills of 73 ft. 6 in. The inside length of these cars is 72 ft. 10 in., which allows a commodious space for handling baggage. The distance between truck centers is 52 ft. 5 in. The same type of truck and brake equipment is used on both the baggage and passenger cars. The outside width over the eaves and the width between the sides posts is the same as that of the passenger cars. This design of superstructure permits an inside clearance of 9 ft. 3/8 in. in the baggage car. The height from the rail to the top of the floor is 4 ft. 6 3/8 in. The empty weight is 146,000 lb.

All of the cars are provided with the Westinghouse UC-1-18 equipment and clasp brake. Miner friction draft gear and buffers are used. The trucks are the Commonwealth

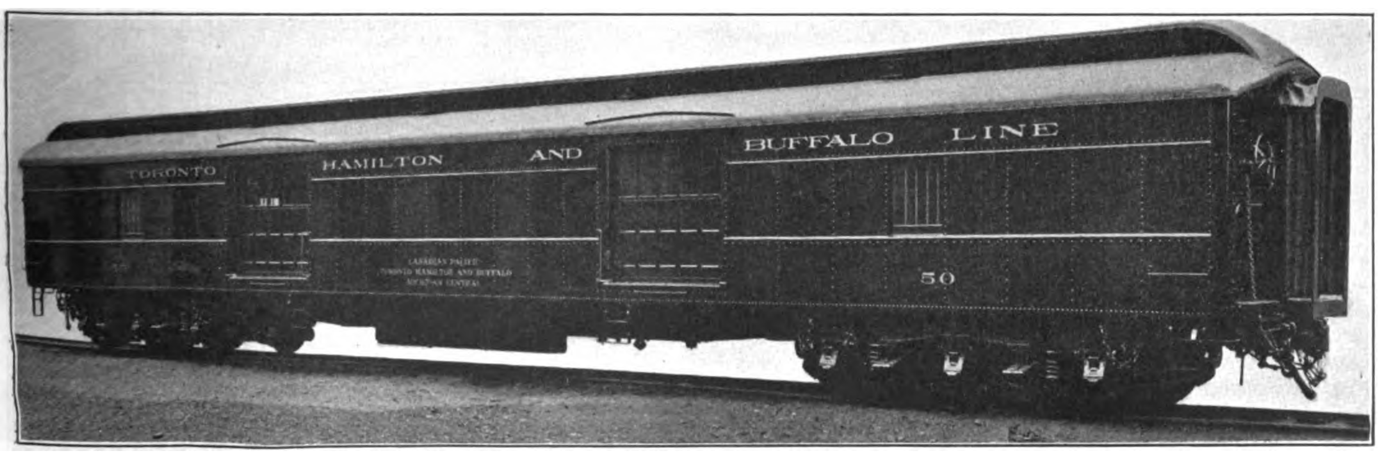


Interior View of a Baggage Car Before the Roof and Insulation Is Applied

cast steel design and have 36 1/4 in. wheels with cast steel centers and 5 in. by 9 in. A. R. A. axle journals.

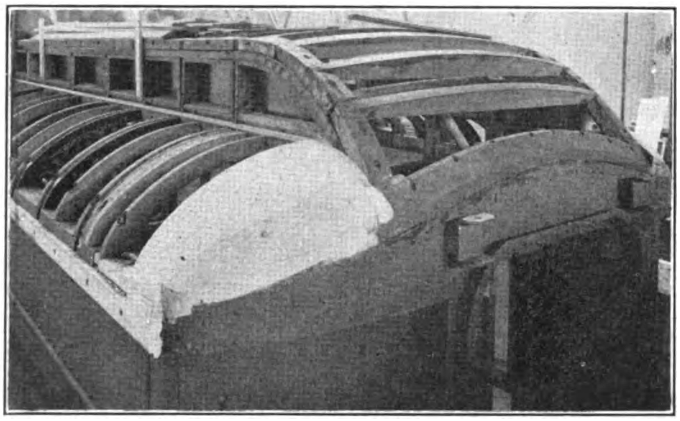
Construction and Insulation of the Walls and Floors

The floor is made of 1/16-in. steel plate. It is insulated at the center of the car and at the doorways by three-ply salamander, a 3 in. air space; bottom wood floor 3/16 in. in thickness; one layer of asbestos-asphaltum paper; 1/16 in. reeferite; one layer No. 14 asbestos-asphaltum paper, and a top wood floor 1 in. thick. The end flooring of the car is insulated by one course of three-ply salamander, a bottom floor 1 in. thick; one layer No. 50 asbestos-asphaltum paper; 1/16 in. reeferite; one layer No. 14 asbestos-asphaltum paper, a top wood floor 1 in. thick, and 1/4 in. reeferite, with 1/16 in. of sand rolled into the surface. Movable floor racks



New Baggage Car Recently Built for the Toronto, Hamilton & Buffalo

are applied at the end section as is shown in one of the illustrations.



Wood Nailing Strips Are Bolted to the Steel Frame of the Roof

The walls are insulated by one course of one-ply salamander behind the head lining, two-ply salamander on the letter plate at the windows, and ½ in. Keystone hairfelt on the pilasters, ends and under the windows, together with one course of three-ply salamander. The interior is finished in figured African walnut. The roof is of all-wood construction resting on the steel framework, as is shown in one of the illustrations. It is covered with No. 6 white canvas embedded in white lead and is secured to the root with copper tacks.

The Illumination and Heating System

The illumination is provided by an electric lighting system, manufactured by the Safety Car Heating & Lighting Company, which receives its current from a 3-kw., 30-volt axle generator and Edison storage batteries. In order to equalize the illumination, the bracket lamps in the main body of the car are staggered. The coaches are heated by the straight vapor system which is manufactured by the Vapor Car Heating Company.

Proceedings of the Air Brake Association

Report of the Papers and Discussions at the Thirty-First Annual Convention Held at Montreal

THE proceedings of the opening session of the Air Brake Association Convention, held at the Mount Royal Hotel, Montreal, Que., May 6, 7, 8 and 9, were published in the June issue of the *Railway Mechanical Engineer,* together with the paper and discussion on Freight Car Foundation Brake Design. Further proceedings of this convention are given herewith.

Report on Passenger Train Handling

The question of passenger trains being on time and smoothly handled is receiving much consideration because of competition. The public has been educated to expect high speed, safety and luxuries in the way of service that were not formerly demanded. As a result, they are critical if trains are delayed or are not handled smoothly. The influence these dissatisfied passengers have on others contemplating a trip cannot be discounted.

The fundamental cause of shocks to trains is a sudden change of slack, either in or out, and is produced by a rapid change of velocity between the various units comprising the train. Shocks are caused by starting quickly, taking slack harshly or restarting quickly after taking slack. The action of the brakes in changing the slack will be the most severe at low speeds. Therefore, make any brake application suit the speed, being careful to avoid heavy brake applications at low speed.

Co-ordinating the Throttle and Brake Valve

It is desirable to avoid a change in the position of the throttle and the use of the air brakes at the same time. This is important if the action of either will change the train slack in the same direction. Under such condition the effect would be intensified if both were used at the same time. Do not open the throttle until all brakes have had time to release. For slow speed stops, do not shut off and immediately apply the brakes. Either shut off gradually a few seconds previously, according to conditions, or apply the brakes to a proper degree and later reduce the throttle gradually until shut off.

A few seconds of time allowance for the effect of the action of the throttle and another few seconds between the initial and subsequent reductions is of such vital importance in the operation of long passenger trains that the time element cannot be ignored, more especially on long trains and slow speed stops.

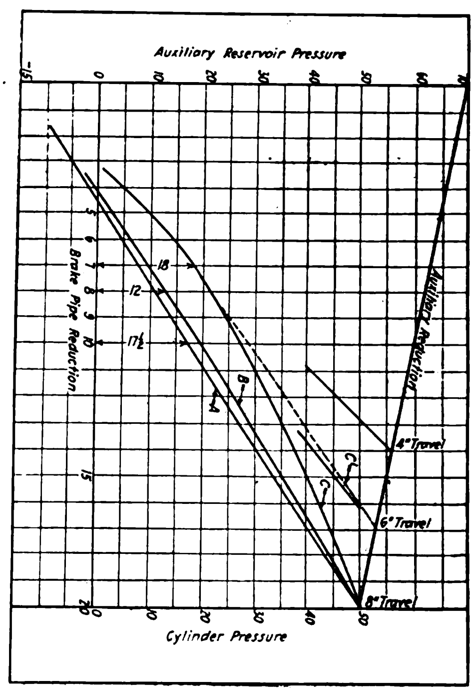


Fig. 1—Chart Showing the Relation of Cylinder Pressure Per Pound to Brake Pipe Reduction

Sleepers and observation cars at the rear ends of passenger trains, braked at 75 per cent on 50 lb. cylinder pressure (equivalent to 90 per cent on 60 lb.) seldom lose much of their maximum retarding effect because they are not loaded

cars. Day coaches are semi-load cars, while the baggage, mail and express cars just ahead, although braking at 75 per cent when empty, are usually loaded so that the average retarding force is around 45 to 55 per cent of the total load. Forward of these is the locomotive varying from 35 to 41 per cent in brake force, in proportion to the working load. It will be seen that the modern passenger train running forward will stretch after all brakes are applied and stretch harder as the brake force is increased. The opposite is true of a backing train; after all brakes are applied the train bunches and remains so until the brakes are released.

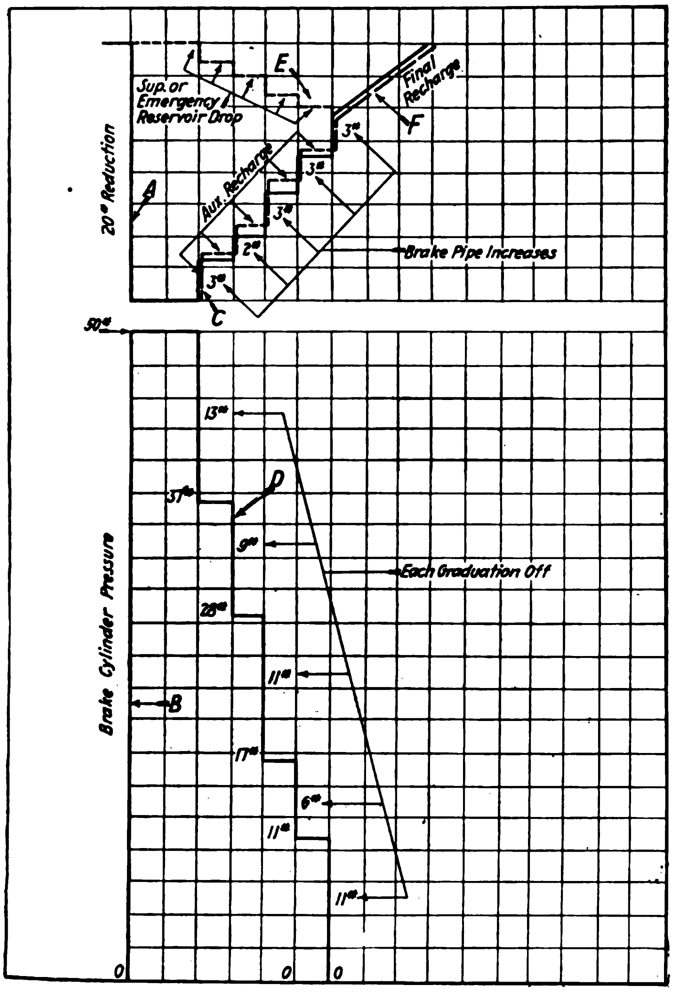


Fig. 2—Chart Illustrating the Action of the Pressures on an Individual Release Brake

The brakes nearest to the point in the train where the reduction is started are the first to begin to apply. With a train running forward and the brake pipe reduction started from the head end, the tendency is to start bunching. After the brake pipe reduction is effective on the rear, the train stretches again. If the train is backing and the back-up men are controlling, the rear brakes start to apply first which tends to bunch the train, beginning at the rear. Therefore, a very moderate use of steam by the engineer to keep the slack in until he feels the brake begin to hold, will materially assist in producing a smooth stop. This is equally true if the engineman stops the backing train. Do not shut off entirely until the reduction has been sufficient to have all brakes applied throughout the train. Keeping the locomotive brake released at this time assists materially.

Slack Adjustment

The action of the automatic brake is based on piston travel. Very few actually realize what this means. Many cases of rough handling can be traced to short piston travel, leading to inability to develop a low cylinder pressure for a reduction of six to seven pounds. It is true that many of the older forms of passenger foundation brakes have a great deal of deflection, which causes the piston travel to elongate excessively as the cylinder pressure is increased, primarily owing to high total leverage and weak members. Added to this is an increase of 1½ in. to 2½ in. difference between full standing and running travel due to trucks settling.

The modern clasp brake has about ½ in. difference between standing and running piston travel, very little deflection and longer piston travel for the initial reduction, with a corresponding lower pressure at this moment. Clasp brake cars should be adjusted to not less than 7½ in. standing travel with a full service brake application. Roads doing this are getting very good results. Some roads are adjusting the other types of foundation brakes at 7½ in. standing travel also, thereby obtaining smoother brake operation. One property which has only the low hung, single shoe, six wheel trucks, makes it a practice to start the trains with 7½ in. standing travel and let them out at one point on the line on coast trains, about half way between the extreme terminals, thus obtaining better results.

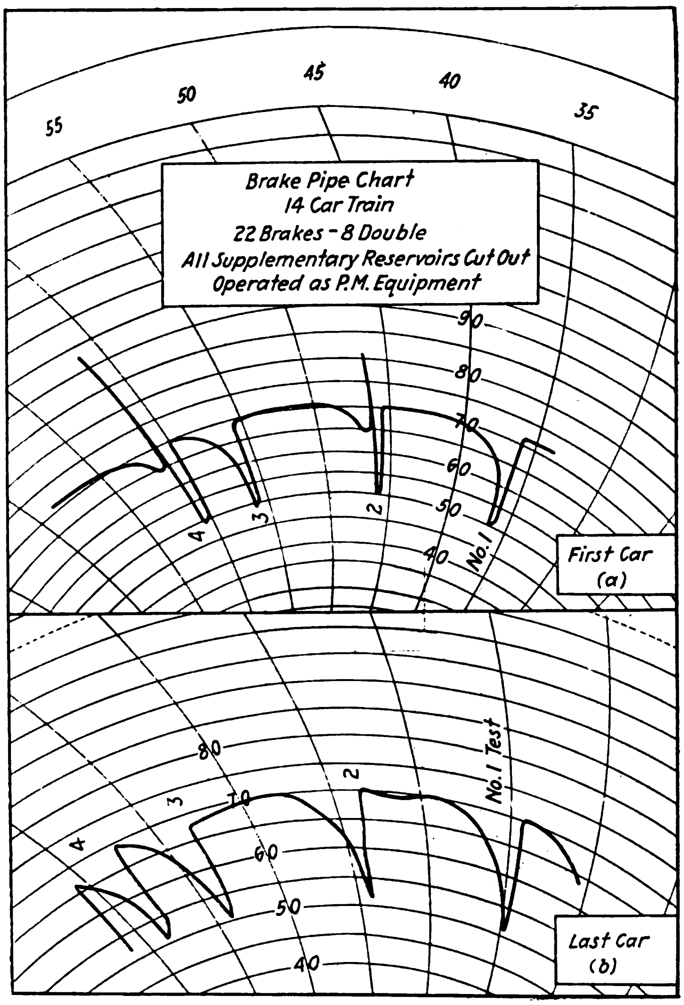


Fig. 3—Section of Recorder Chart Taken From the First and Last Cars

Fig. 1 is illustrative of what is desired and what frequently occurs. Line *A* represents the desired cylinder pressure per pound of brake pipe reduction. Line *B* practically represents what occurs with a modern clasp brake, while lines *C* and *C'* show what happens on cars with the least desirable foundation brake conditions. With such brake adjustment

as shown on line C, long trains cannot be smoothly handled by the engineman.

Graduated Release

There are two types of graduated release brakes in use for steam road service, known as LN and UC. When an experienced air brake man thinks over the flexibility of the straight air brake, with its ability to be graduated off to produce less deceleration, he does not wonder that graduated release was incorporated in the automatic brake.

The one application, graduated-off stop, requires less distance than the two application stop, and also less time. It assists in making schedule time. Smoother stops are accomplished because the train slack adjustment is usually made only once and at the beginning of the stop while the speed is highest, and because the brakes are coming off near the end of the stop. The engineman is enabled to correct his judgment of speed and distance after he has used the brakes sufficiently to be sure he is inside the stopping distance by enabling him to graduate off to place the train at the desired location. This avoids an entire release and reapplication, which, under some conditions of speed and distance to final stopping point, causes rough handling.

Where the brakes are graduated off properly, long trains are more easily started because the train stretch is reduced and draft gears released to nominal position while the train is moving. The ability is present more surely to move all triple valve or equalizing portions of brake equipments to release position, causing less stuck brakes because graduated release, quick recharging brakes require an increase of brake pipe pressure only. This increase can be made quite rapidly.

The auxiliary reservoir recharge is taken care of by the air pressure from the supplementary or emergency reservoirs until the brake is entirely released. This avoids a drain on the brake pipe pressure while the release is being accomplished. It also permits several reapplications of the brake in quick succession without materially depleting the system. After the quick recharge feature has been entirely absorbed, the final finish of the recharge of all reservoirs comes from the locomotive through the brake pipe.

Individual Graduated Release Brake

Fig. 2 illustrates the action of the pressures as caught by gages on an individual graduated release brake. Line A represents the brake pipe reduction. Line B illustrates the resultant brake cylinder pressure. Lines C, solid and dotted, show the increases of brake pipe and auxiliary pressures while graduating off. Line D indicates the graduated release of cylinder pressure. Line E corresponds to the supplementary or emergency reservoir drop while it is recharging the auxiliary reservoir. Lines at F represent the final recharge of reservoirs from the brake pipe.

Figs. 3 and 4 are sections of two recorder charts taken from the forward and rear portions of a 14-car, LN equipped

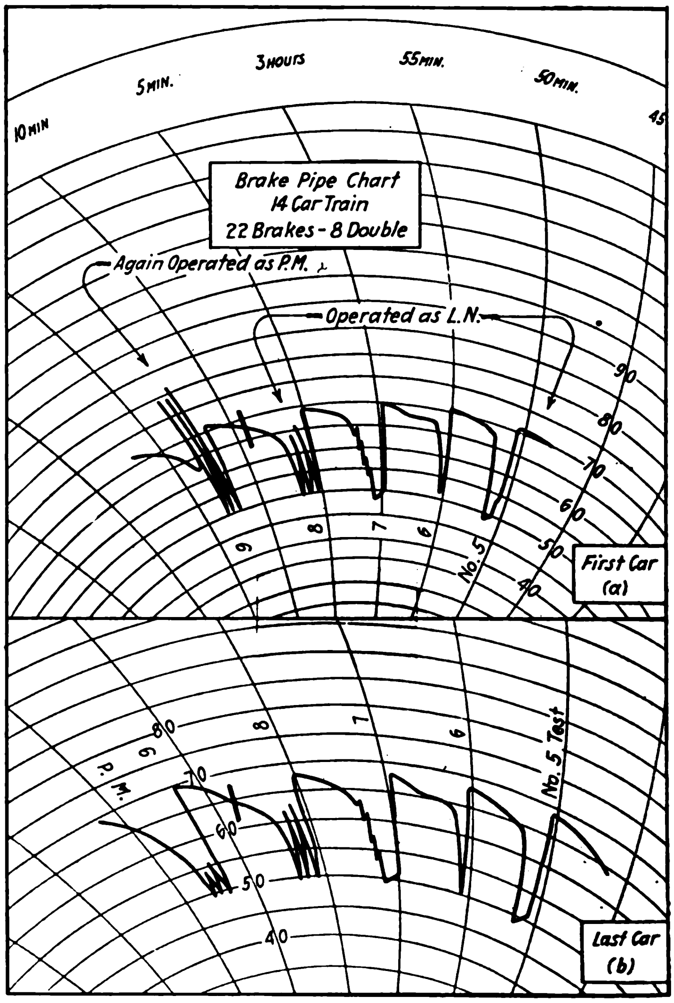


Fig. 4—Action of the Pressures on an Individual Release Brake with the Supplementaries Cut In

train with 22 brakes; 8 cars having double brakes. All equipment was first operated as PM, the supplementaries being cut out (see Fig. 3). Tests Nos. 1 and 3 are running position releases. Tests Nos. 2 and 4 show release position used for a limited length of time. Observe the slow rise of

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brake pipe pressure at the rear end of the train on account of the drain by the 22 auxiliary reservoirs.

A Comparison

Compare these with the events on Fig. 4 in which the supplementaries were cut in on the first four of these tests. Test No. 5 shows running position release. Test No. 6 shows release position, then running position the balance of the time. Test No. 7 shows running position and lap step-ups. Test No. 8 shows running position, three releases and three reapplications in quick succession. Note the rapid and nearly equal rise of the rear and forward brake pipe pressures on each release. Test No. 9 shows supplementaries cut out again and three similar releases and reapplications. This time the brake valve was used in release position only until the forward brake piston returned into the cylinder, when a reapplication was made. Note how impossible it was to drive the air through the brake pipe rapidly owing to absorption by the numerous auxiliary reservoirs.

Usually about 50 sec. or less are consumed in making the stop, while not longer than 15 to 20 sec. of this are used while the brakes are being graduated off. The average time for the long train two-application stop requires from 60 to 75 sec., if done as intended.

Two positions of the brake valve are used to increase the brake pipe pressure while graduating off, the release position and the running position. The release position furnishes a rapid rise, generally used for the first graduations off on long trains, for recharging on grades or for releasing the last graduation where it is desired to reduce the cylinder pressure quickly. The running position supplies a smaller, but effective opening for subsequent graduation on long trains and all graduations off on shorter trains.

75 Per Cent Sufficient

Frequently graduated release trains contain a few PM equipment brakes. It has been shown that if three-fourths of the train is graduated release equipment, good graduated release operation can be performed. When PM equipment cars are in graduated release trains, they release entirely when the first graduation off is made. A good graduated release engineer will pay no attention to a few PM cars. He usually governs himself by way the train decelerates after the first graduation off.

Retaining valves should be used on graduated release trains, the same as PM equipment trains, whenever the brakes cannot be recharged to 80 lb. When operating with retaining valves, be sure that the application is sufficient to insure a release, so that the train is retarded by retaining valves and not by sticking brakes. Graduated release must not be used when retaining valves are in operation. Where retaining valves are not cut in and graduated release is depended on, not more than one release graduation should be used between complete recharges. Use release position of the brake valve when recharging and follow with a kick-off.

Where trouble is experienced with brakes sticking on graduated release equipment after locomotives are changed, or switch engines are used to change the make-up of train, this is primarily caused by a difference of brake pipe pressure adjustment on the different locomotives. The locomotive not experiencing this trouble has the higher pressure, possibly too much, while the one having the trouble has the lower pressure, possibly below the authorized amount.

A good practice to follow when changing engines is to leave the brakes applied by the delivering engine after stopping. The receiving engine releases them and when the test of the brakes is made, it will eliminate any trouble due to a slight difference of air pressures between the two locomotives.

All road engines should have the regulators set close to a uniform pressure, and all switch engines should have available air pressure adjustment so that when handling a train the pressure can be raised to the amount authorized for that train.

The report was signed by James Elder, C. M. & St. P.; W. J. Devine, C. & N. W., and L. M. Carlton, Westinghouse Air Brake Company.

Discussion

The discussion of this paper dealt largely with the relative merits of the graduated and direct release. It was brought out that many engineers liked the graduated release better on account of being able to make smoother stops with greater ease than with the direct release. Some of the roads handling heavy passenger trains use the graduated release on all trains equipped with the PC equipment and require the use of direct release on trains equipped with the LN equipment. On account of the large number of roads having to handle Pullman equipment in the same train with company owned cars the fact was brought out that the Pullman Company recommended the use of the universal equipment on all of its cars, as the UC type is designed to operate with the PC, LN, or with any other type of brake equipment.

The discussion brought out that there are two principal factors entering into the decision as to what release should be adopted. One is the operating conditions, which must be given careful consideration; the other is the amount of instruction that can be given to enginemen. The effect of climatic conditions, such as are encountered by the roads in Canada, as well as the character of the terrain through which the roads run, have a vital effect on brake operation, and the roads are required to adopt equipment that would permit

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the greatest factor of safety and reduce wear on the brake shoes and slide flat wheels to the minimum.

The question of the use of the retainer was brought up by the president and it seemed to be the opinion of the convention that the retainer should not be used with the graduated release. One member stated that his road left the use of the retainer up to the judgment of the engineman and conductor and after a short time it was discovered that its use had gradually died out. Various opinions were expressed as to the use of the graduated release with the PM and LN equipment. Some members reported that their roads used the graduated release with both types and were getting very good results.

Brake Pipe Leakage

During the year the committee which investigated the subject of Air Consumption of Locomotive Auxiliary Devices, on which it rendered its final report at the 1921 convention, was assigned the subject of brake pipe leakage. The assignment was made too late to permit an investigation this year, but the committee reported that it has formulated a program for the ensuing year for the purpose of developing data to support definite conclusions and recommendations on the following questions:

(1) What is the average leakage rate for trains in current service?

(2) What is the ratio between the amount of compressed air used for braking and the amount of air wasted in maintaining unnecessary leaks?

(3) What degree of leakage can be tolerated without serious interference with train operation?

(4) What is the unit cost of brake system leakage?

(5) What are the most efficient methods of inspecting and testing and repairing brake system leaks?

(6) What degree of maintenance expense is justified in the light of existing conditions?

The members of the Committee are C. H. Weaver, New York Central, chairman; C. B. Miles, Cleveland, Cincinnati, Chicago & St. Louis; W. W. White, Michigan Central, and R. E. Miller, representing the Westinghouse Air Brake Company.

Discussion

The discussion was opened by a member asking the question, "Where does the greatest percentage of pipe leakage take place?" In the attempt to settle this question various points on the train lines were mentioned, of which the hose and coupling received the most frequent comment. President Wood expressed the opinion that the committee should investigate the possibility of increasing compressor capacity sufficiently to offset leakage from 5 lb. to 8 lb. per min. Some of the members maintained, however, that increased compressor capacity meant increased carelessness on the part of many inspectors and no advantage would be obtained. It was generally agreed that any leakage amounting to 8 lb. or over should be reduced before the train left its initial terminal.

R. M. Long (P. & L. E.) said that the place to stop leaks was on the rip track. There was no economy in waiting for a train to be made up before testing, for if considerable leakage was discovered it meant a delay. The utilization of the Westinghouse single car testing device was recommended as an effective means for reducing leakage in air brake piping.

Various means for detecting brake pipe leakage were discussed, such as using the 95-car rack and making a 10-lb. reduction from a 70-lb. pressure. The advantages to be obtained by testing the train line with the train stretched and the possibility of increased leakage due to drawbar action while on the road were mentioned.

Attention was also called to the fact that the bad practice of pulling hose couplings was quite common and that many car men persisted in the practice of turning gaskets. A strain of from 1,200 to 1,400 lb. is exerted every time a hose is pulled apart at the coupling.

It was recommended that the work of this committee should be continued and that its report should also take into consideration the maintenance of hose, as it was an important factor in leakage.

Interesting Employees in the Study of Air Brakes

By J. P. Stewart

We know of very few subjects on which knowledge can be as extensively and easily obtained, and at as small a cost, as knowledge of the air brake equipment. Pamphlets that are interesting and attractive are published by the manufacturing companies and gladly sent to applicants, postage paid, for the mere asking. Pages in the different railway and union magazines are devoted to explaining and picturing the features of the equipment. So it is possible for any man to build up a nice technical library on this subject with practically no cost. For a very modest price the splendid books which the Air Brake Association publishes are to be had. Then the railways and other companies place means of instruction and education at the command of the men.

But in spite of all these opportunities we have to admit that there is a failure somewhere. As a result the average railway man begins to grow restless as soon as the subject of instruction is broached. And I fear this is a condition that will continue to exist until someone makes an instruction class appear as attractive as a musical comedy or a band concert.

Instruction cars and instruction rooms are good. But there are those who attend just as a matter of duty and who at the close of a class are not able to tell what was talked about. There are many like a fireman I met at a small terminal. He came up to the instruction car after closing time and requested permission to register, saying, "I want to get my name on the register so the trainmaster will not make me follow the car. But I have been in the car once, a year ago, and know everything in there." Now this fireman did not know everything in there. In fact, I know that he could not as much as test a feed valve. I fear that the average man wants just enough instruction to get by. As a result instruction cars and instruction rooms lose their hold as soon as the newness wears off. But if properly backed up we believe they can accomplish great good.

This committee would like to recommend that every air brake instructor, road foreman of engines, and every official secure copies of the instruction pamphlets issued by the Westinghouse Air Brake Company, and read the preface entitled "How to Study the Air Brake."

Arrange for places where the men can loaf and talk air brake, or settle arguments. Encourage arguments. By that way we get the other fellow's opinions and ideas. Have charts and books and parts of the equipment where the men can have access to them just by themselves. If possible have an office or room at each terminal where the men can get the information necessary to decide their arguments, and where they will like to loaf. Then surround them with air brake material, literature and charts. Have the men understand that this is their room. If you haven't any clubroom or recreation room at that terminal, have some card tables and checker boards in your instruction room. Make it attractive.

Talk to the new firemen. Have them understand that before they become enginemen they must understand the air brake equipment. And have them understand that the only method is to start studying when they start firing. Then have first, second and third year examinations of firemen. In these examinations have some air brake questions suitable for a man with their length of service, and insist on the men passing these examinations. Then have a good, stiff examination when the fireman comes up for promotion.

It should be made possible for the men to keep posted on all new devices. Make it interesting for them to talk about these devices. And then try and have your company require the men operating and maintaining the air brake equipment to take an examination at least every three years. Men maintaining and operating air brake equipment are in a position such that a failure on their part, or a misunderstanding of the proper method of doing their work, may result in great loss. The man who is willing and trying to learn and advance, the examination will be welcome. For the man who just wants to get by, the examination is a necessity.

Never fail to take time to answer questions, regardless of how small or how foolish they may be. If some one asks a question that is new or has you guessing, play fair and tell him that he shows good sense in getting that deeply into the subject, and that you will have to study it out before answering. Don't try to bluff it out by getting technical; the more you talk, the worse you will be in. All the men in the class will enjoy your embarrassment, and also lose confidence in your teachings.

If possible, form air brake clubs during the winter months, and have monthly or semi-monthly meetings. Have the men from two or three terminals at each meeting, and create rivalry between the terminals as to who can produce the best paper. To do this it is necessary to have the transportation department with you. This can be done by having the transportation officials as members of your club.

Discussion

A brief discussion of Mr. Stewart's paper brought out the necessity of getting something new to keep the men's interest aroused in their work. The instruction car should be made attractive so as to make the men want to use it. The idea of arousing a competitive spirit among the men by choosing some man having a high standing and using him as an example was also suggested as getting good results.

The Triple Valve Test Rack Operator

By the North-West Air Brake Club

The importance of picking the man cannot be overestimated and is too often done hurriedly, with little, if any, consideration as to the fact that he should be able to read and write English, be properly inquisitive, able to listen when others are talking, have keen eyesight and good physical health.

At a cleaning point where no heavy triple valve repairs are made, merely cleaning, lubricating and light repairs, the candidate should have had at least two months' experience on brake cylinder cleaning and triple valve changing and the same period on triple valve cleaning. At a point where heavy repairs are made, the foregoing experience should be supplemented by enough work in heavy repairing to make him competent in this. Obviously, this latter experience should be obtained under the supervision of a competent repairman.

Where seniority must govern more or less in promotion, it is all the more important to exercise care in the selection of men for the work of brake cylinder cleaning.

Experience in brake cleaning, particularly that of cylinder work, is important, as it is impossible, even with the best quality of triple valve work, to have good brakes when brake cylinders are slighted. In the last analysis, the efficiency of a brake depends on the brake cylinder being in perfect condition. For this reason, although properly not under the subject of the paper, we wish to warn against the too common attitude that anybody can clean brake cylinders, when assigning men to such work. Our air brake mechanics should come from among these men. The man who satisfactorily meets the above requirements will ordinarily give little trouble to the general air brake inspector in the more advanced work to follow.

Relative to starting the instruction of a man on the test rack, it should be borne in mind that a little, well learned is of greater benefit than that which is poorly learned. Consequently, the more important tests, such as charging and testing the emergency piston and ring, should be the first in which he should be drilled. As a man becomes acquainted with the construction of the rack and the purpose of the tests, the individual test will no longer be a matter of memory, but a reasoning from cause to effect, with the object a perfect operating valve.

Along with this part of the work, the operator should be instructed on the care of the rack. Definite periods, not less than once each week, should be set for this work, at which time all operating parts should be thoroughly cleaned and lubricated and the rack tested for leaks. Satisfactory life and operation of the rack depends on this systematic care. Too often a poorly maintained rack results in poor as well as unnecessary work being done.

As few men picked for triple valve work have had special mechanical training, care should be taken not to add repair work, such as the slide valve and ring, too rapidly. It is an easy matter to bewilder and discourage a man by unloading the more accurate work on him before he is ready. The instructor should do some of the heavy repair work before suggesting that the student try his hand with a file, scraper or lapping plate.

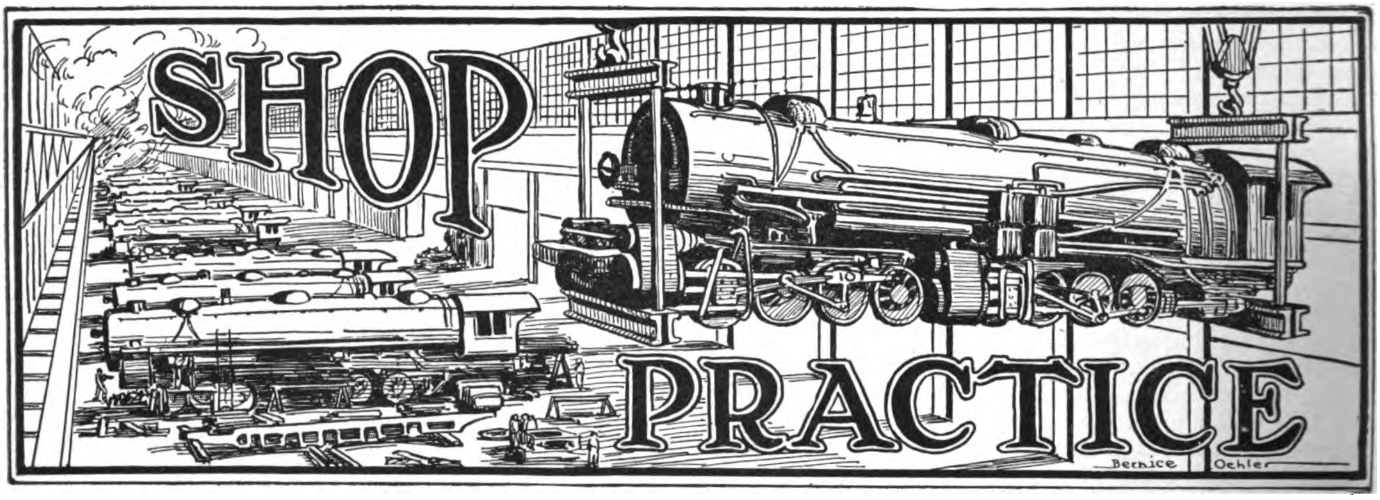
The value of such a man should hardly have to be pointed out in detail when the importance of correct brake operation is considered. First, in train safety; second, compliance with the Federal laws; and third, avoidance of train delays and damage incident to break-in-twos and stuck brakes. Then, there is the keeping down of the cost of the cleaning and repairs to triple valves. A competent rack operator will see that the character of work done on valves coming to him for testing is such as will reduce the rejections, with repetitions of such work, to the minimum possible.

Discussion

Considerable comment was made relative to the question of seniority, which seemed to conflict with the selection of an efficient test rack operator. It was generally agreed, however, that it was up to the air brake supervisor to see that the test rack operator receive the proper education. It was considered that one man with a 2-T rack should be able to test as high as 50 to 60 triple valves in an 8-hour day. There was also considerable discussion as to the knowledge that should be required of a test rack operator and that his pay should be increased as he does better and more efficient work on the test rack.

Other Papers

A report was also made by the Committee on Recommended Practice by the committee appointed to investigate the condemning limits of A. R. A. standard triple valves. It was decided to hold the last report over until next year in order to give the committee an opportunity to make further investigation.

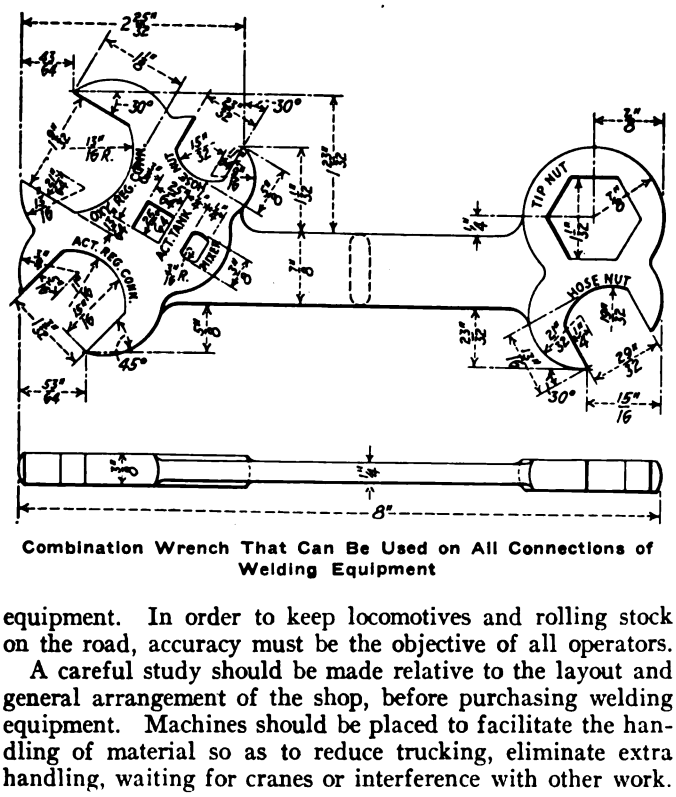


Welding Equipment in a Railroad Shop

Modern Tools Should Be Provided So That the Operator May Perform More Accurate and Efficient Work

By James S. Heaton
Welding Supervisor, Wabash, Decatur, Ill.

WELDING, as it is practiced today, is one of the most important processes in the railroad shop. To perform welding successfully, in any shop, the equipment should be of modern design and up to date for all requirements. Therefore, great care should be exercised in the selection of equipment, by purchasing only those tools which are best adapted for certain shop operating conditions. Modern tools have the advantage of enabling the operator to complete a more accurate job than it is possible to do with obsolete



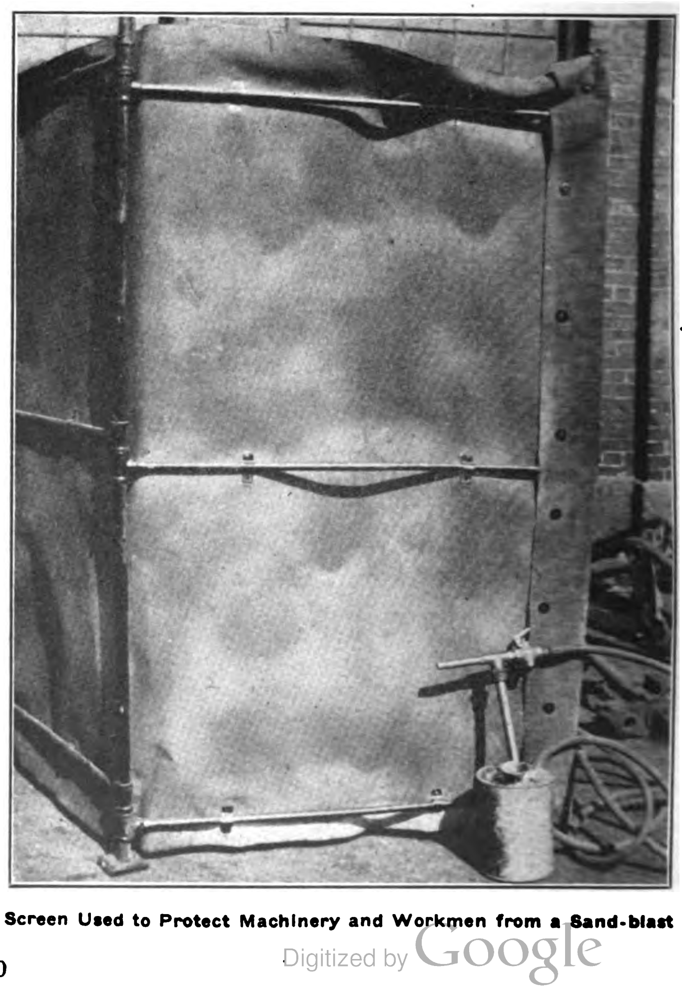
Combination Wrench That Can Be Used on All Connections of Welding Equipment

equipment. In order to keep locomotives and rolling stock on the road, accuracy must be the objective of all operators.

A careful study should be made relative to the layout and general arrangement of the shop, before purchasing welding equipment. Machines should be placed to facilitate the handling of material so as to reduce trucking, eliminate extra handling, waiting for cranes or interference with other work.

Acetylene Equipment

The equipment necessary for acetylene welding and cutting is shown in Fig. 1. It consists of two regulators, one for oxygen and one for acetylene; sufficient hose to connect the



Screen Used to Protect Machinery and Workmen from a Sand-blast

regulators and the torches,—of which there are two, one for welding and one for cutting,—a gas lighter, a pair of goggles and a combination wrench.

This equipment is mounted on a four-wheel truck equipped with ball bearings. On the bottom of the truck is a sheet

Fig. 1.—Portable Acetylene Equipment Used on the Wabash

of rubber two inches thick for the drums to stand on. The rubber is intended to absorb the shocks to which the drums are subjected while being transported around the shop.

The welding torch shown in Fig. 1 is manufactured by the

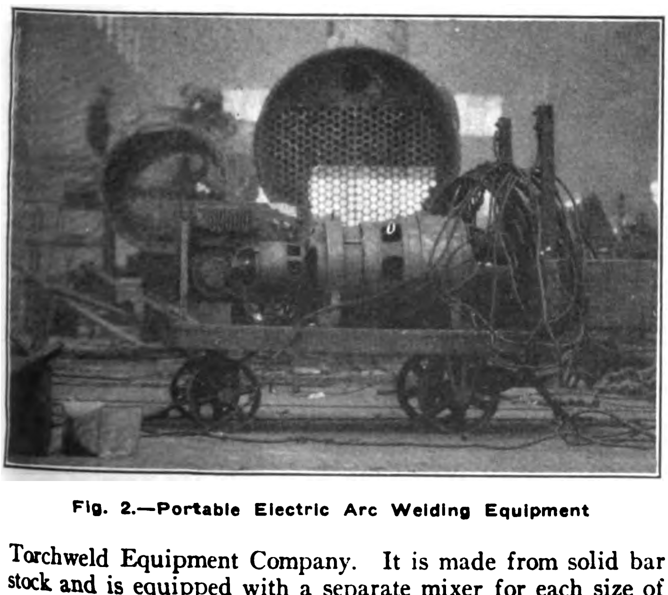


Fig. 2.—Portable Electric Arc Welding Equipment

Torchweld Equipment Company. It is made from solid bar stock and is equipped with a separate mixer for each size of tip. The cutting torch, manufactured by the Henderson-Willis Welding Company, is of the flat head design with the tip nut on the outside. The regulators are equipped with a three-piece steel diaphragm. This design tends to eliminate any buckling or breaking of the diaphragm due to the regulating screw being used while changing torches.

It is essential that the hose used for gases be of the best grade obtainable, for the service demands both ability to withstand wear and safety. The hose used on this road is made by the Gustin-Bacon Manufacturing Company and is a three-ply fabric, heavily rubber coated, designed to withstand hard usage. They are made in two colors in order to avoid the possibility of attaching the hose to the wrong connection. Red is used for acetylene and black for oxygen. As a further precaution the connections are also threaded right and left hand, right for oxygen and left for acetylene.

Goggles and Safety Equipment

The goggles, made by the Willson Goggle Company, are designed to afford the best ventilation and protection to the welder. This goggle has ventilating cups on each lens holder which afford the proper amount of air needed and is equipped with rubber tubing around the base which keeps out all sparks. The lenses are colored to keep out the rays injurious to the eyes.

To eliminate the practice of using matches to light the

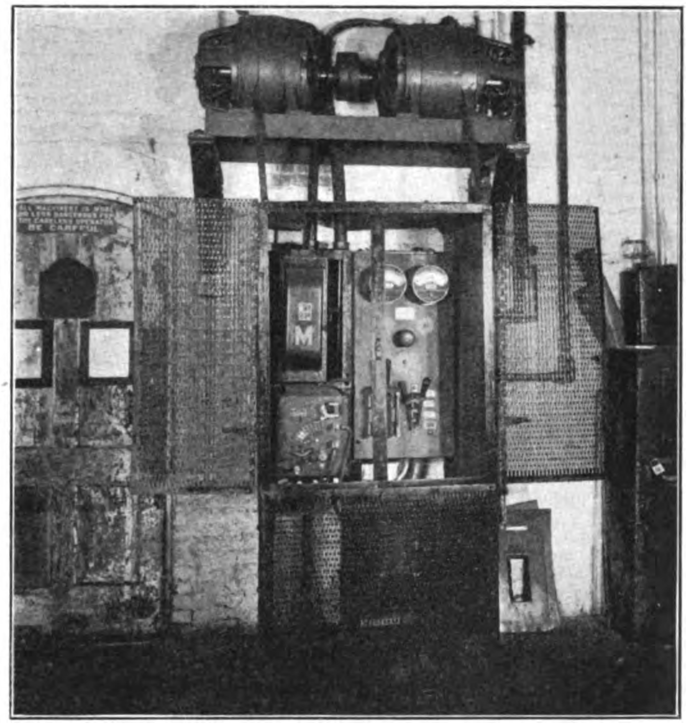


Fig. 3.—Stationary Type of Electric Arc Welding Equipment

torches, which is a waste of time, a gas lighter of the round file design, manufactured by the Safety Gas Lighter Company, is used. It is operated by a slight movement of the hand and is quite an improvement over the old method of lighting torches.

The wrench, shown in the drawing, is a combination of several wrenches in one. It can be used on all connections on the welding and cutting equipment. To prevent misplacing it the wrench is equipped with a small chain, four feet long. One end is welded to the wrench and the other is welded to the truck. A box of sand to be used in extinguishing fires started by sparks, and a bucket for cooling the torches, completes the equipment.

Electric Arc Welding

The principal advantage of arc welding is that it utilizes the heat between the electric arc and the material to be welded and confines the heat to a small space, thus reducing

the expansion or contraction. It is not necessary, however, to preheat wrought iron or steel when using the electric arc. Fig. 2 shows a machine manufactured by the Lincoln Electric Company. It is a direct current motor-generator type which is mounted on a truck with ball-bearing wheels. The open circuit voltage ranges from 40 to 100 volts. The reduction in voltage to that required by the arc is brought about by a series field and armature reaction. The arc may be drawn up to ⅝ in. and may be held for a short interval without breaking. This is accomplished by the use of a heavy inductive ballast or stabilizer and a complete laminated steel magnetic circuit. Fig. 3 shows a stationary type which may be placed on a wall or column and requires little floor space. The control equipment of both machines consists of an ammeter, voltmeter, field rheostat and circuit breaker which is mounted on a panel board.

The apparatus necessary for arc welding equipment consists of two 100-ft. cables, one for service and the other for a ground wire, an electrode holder which is connected to the service cable and a clamp, which is soldered to the ground wire and is used to make a tight connection to the material to be welded. A helmet equipped with a special glass designed to keep out the glare and protect the face from the ultra violet rays which arc welding produces, is also provided. A wire brush for keeping the material clean before and during welding completes the equipment.

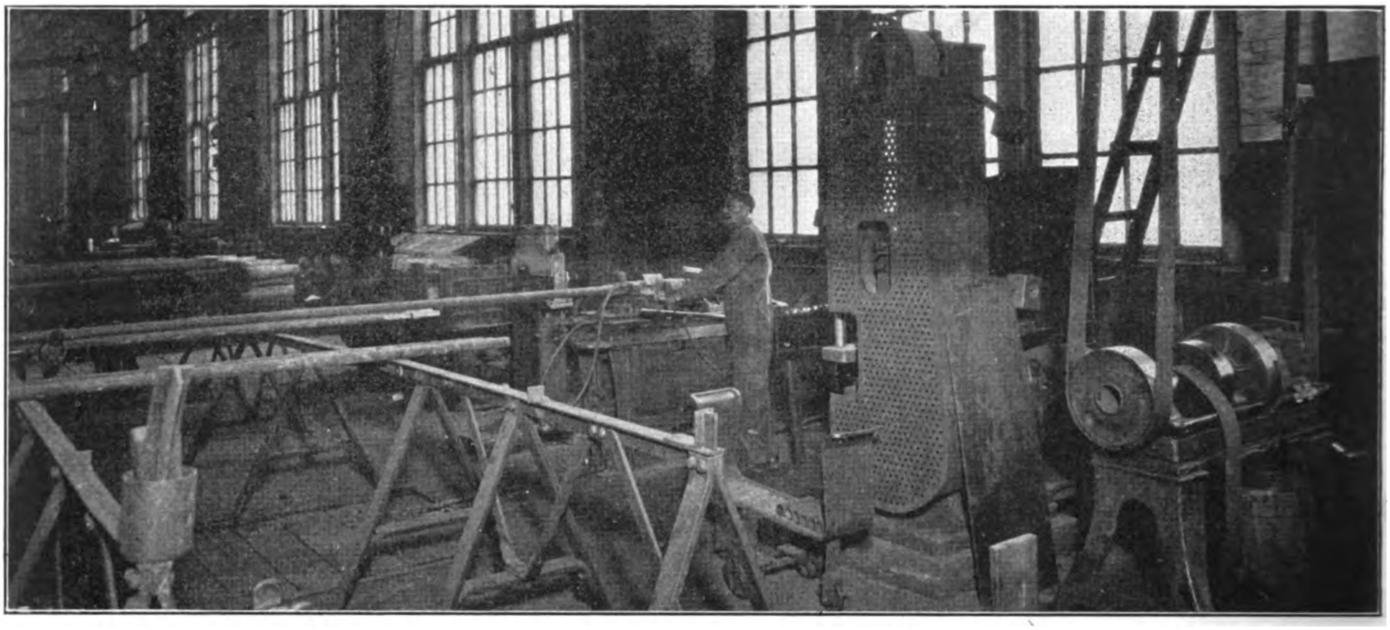


Fig. 4—After the Tubes Are Placed on the Rack No Further Lifting Is Required Until All Operations Are Completed

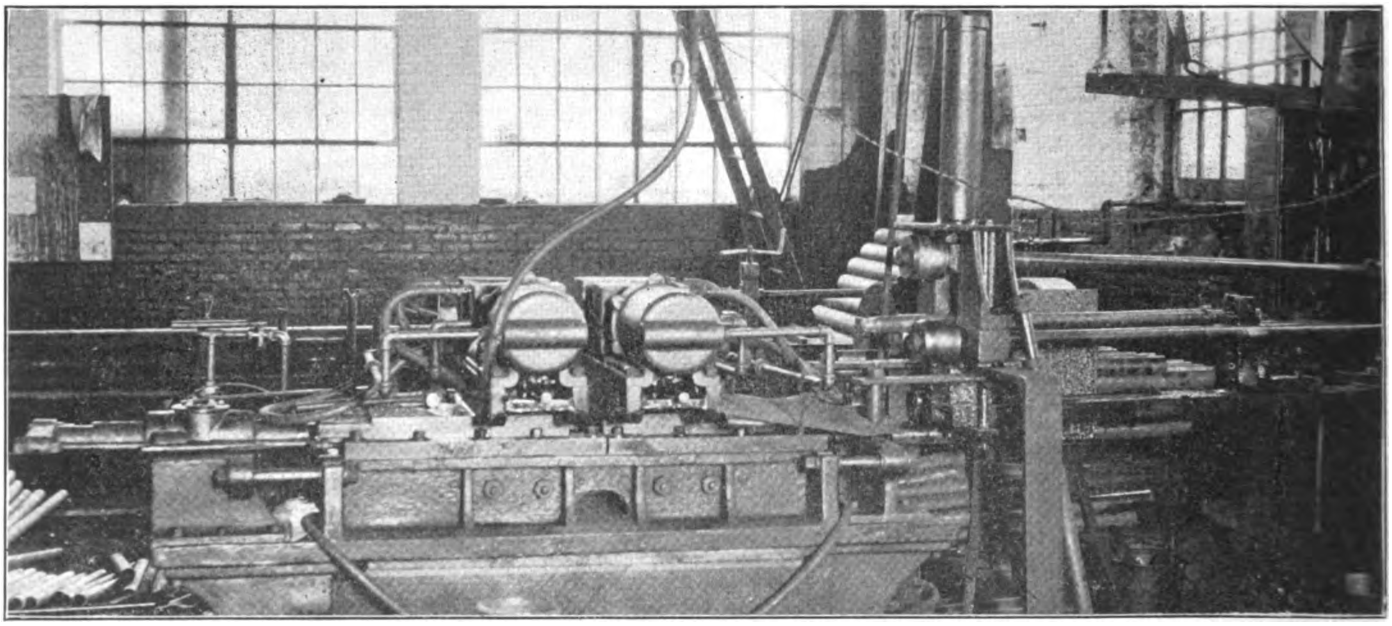


Fig. 5.—This Machine May Be Used for Reclaiming Pipe as Well as for Welding Flues

Electric Flue Welder

Flue welding has been brought to a high state of efficiency by the use of the electric flue welder, as shown in Fig. 4. This machine is made by the Thomson Electric Welding Company and has been recommended by the Master Boilermakers' Association. At the present time it is handling an average of 75 flues per hour. The operation of the machine shown in the illustration is very interesting. After the tubes are cut off they are placed on an elevated rack and all op-

erations are completed without further lifting. The flues are first cut off and then polished with an abrasive belt and welded. The bulge caused by the welding is reduced and the flues are finally heated in a furnace for swedging.

Fig. 5 shows another Thomson flue welder which may also be classed as a reclaiming machine. It is the common practice to weld safe ends on boiler tubes up to 12 in. only, but this machine is equipped with a new rolling device which makes it possible to apply safe ends up to four feet in length. This machine is also adaptable for reclaiming pipe from 2 in. to 5½ in., which effects considerable saving in a railroad shop. The operation of these machines is safer than the old method of oil welding as there is no smoke, glare, or sparks and the weld is always in full view.

Thermit Welding

The fundamental difference between the thermit and the electric or acetylene processes is that the metal added to

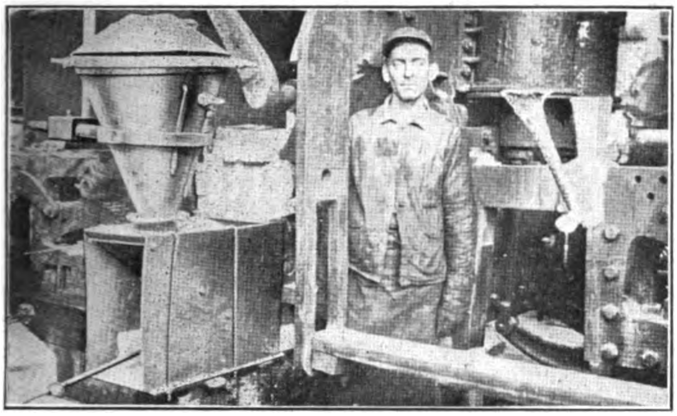


Fig. 6.—Thermit Outfit Set Up for Welding a Locomotive Frame

the broken part is produced in a crucible and is poured at one time. The thermit method is used to a great extent in welding frames as well as in switch and frog work. Fig. 6 shows a thermit outfit set up ready to pour molten metal in a locomotive frame and consists of a crucible in which the thermit is mixed and heated. This sort of a job is performed by cutting out a portion of the frame and filling the opening with a wax mold.

Jacks

When welding frames and structural work it is essential that the proper expansion be secured to produce a solid weld. In most work of this nature a ball-bearing jack should be used. Small jacks should be available to take care of the small frames as well as large ones for the larger frames. Large jacks should be mounted on wheels to eliminate the time usually taken in hunting for a truck.

The Sand-Blast

To make a perfect weld it is essential that the surfaces to be welded be perfectly clean metal. The sand-blast is the fastest and most effective apparatus for producing a thoroughly clean job. The blast used on this road is of the portable type and is operated on the air syphon principle. This syphon consists of a pipe which extends to the bottom of the tank and is equipped with a pipe tee, air nozzle and a sand nozzle, which is operated by a valve. All operations of the sand-blast when used in the shop should be screened to protect the machinery and the workmen. The screen shown in one of the illustrations will answer all purposes. It is constructed of canvas fastened to a frame of pipe, which is constructed in sections of 4 ft. by 7 ft. each, and may be made into as many sections as is necessary for different classes of work.

To maintain the maximum production it is necessary that an air hoist be installed to handle all hot and heavy pieces of material that are in the welding shop. Welding is a nervous and tedious job and all unnecessary strains on the operator such as lifting or working a chain hoist, should be avoided.

Changing Trailing Truck Springs

By John Connelly

Locomotive and Car Foreman, Bessemer & Lake Erie, Butler Transfer, Pa.

ON February 19, 1924, locomotive No. 902 was made ready for train No. 10, which leaves Butler at 2:45 p. m. About 50 minutes before time to leave Butler Transfer it was discovered that the locomotive which is a Pacific type, had a broken trailing truck spring. The engine was placed on the pit at 1:25 p. m. and work was started. At 1:50 p. m. the engine was ready for service, just 25 minutes from the time it was placed on the pit.

The total time consumed by four men in performing the actual work of removing and replacing the spring was 25 minutes or a total working time of 100 minutes, which is equal to 1⅔ man-hours. I think we have established a record that will compare very favorably with terminals that have better facilities, such as a drop pit, pit jack and other devices.

The following equipment is used for this job: A removable section of rail on the pit track, 36 inches long, one fifty-ton jack, one smaller jack and an oak plank, 8 to 10 ft. long by 2 in. thick. The work is performed as follows:

1. Place the locomotive so that removable section of rail is between the back driving wheel and the trailing truck wheel.
2. Let out the driver brakes, place a fifty-ton jack in the pit and remove the section of rail.
3. Move the locomotive back until the driving wheel drops into the opening where the section of rail has been removed. This permits the driving box to drop away from the frame.
4. Place blocks in the space between the driving box and the frame.
5. Move the locomotive forward until the back driver is again on the rail.
6. Replace the section of rail.
7. Move the locomotive forward until the trailing truck wheels are over the removable section of rail.
8. Run the fifty-ton jack that is in the pit out about six inches and then place it, reversed, under the trailing truck axle next to the wheel. Fit and jack high enough for the trailing truck wheel to clear the rail.
9. Place the small jack under the back end of the long equalizer, close to the end of the trailing truck spring and raise the equalizer as far as it will go.
10. Remove the section of rail and lower the trailing truck axle until the weight is off the trailing truck spring.
11. Disconnect the spring hangers and take the broken spring out.
12. Place one end of the plank on the trailer truck journal box and roll the new spring into position.
13. Connect the spring hangers, raise the wheel, replace the section of rail and lower the jack under the equalizer and axle.
14. Move the locomotive back until the trailing truck wheel is off the removable section of rail. Remove the section of rail and move the locomotive back until the rear driver drops into the opening. Remove the blocking from the top of the driving box. Move the locomotive forward until the rear driver is again on the rail and replace the section of rail.
15. Adjust the driver brakes and the job is complete.

Boiler Makers' Convention Proved Successful

Autogenous Welding and Removing Firebox Sheets for Renewal Among Subjects Discussed

THE Master Boiler Makers' Association held its fifteenth annual convention at the Hotel Sherman, Chicago, May 20 to 23. The total registration of members, supply men, ladies and guests was approximately 750, of which nearly 300 were members of the association. The Boiler Makers' Supply Men's Association was represented by 57 different companies whose exhibits were shown on the mezzanine floor of the hotel.

E. W. Young, assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, president of the association, called the meeting to order Tuesday, May 20, at 10 a. m. Following the usual opening exercises, H. T. Bentley, general superintendent of motive power, the Chicago & North Western, was then introduced and, in an address to the men on their duties as the leaders in locomotive boiler maintenance work, expressed his appreciation and admiration of all craftsmen who have gone through the arduous days of the apprentice and journeyman and finally reached their positions as the masters of their trades. These men in whose hands rest the responsibilities of properly conditioning the motive power of the nation, Mr. Bentley said, should strive to be worthy of their trust and in every way better themselves in their work, and the managements of the railroad should see to it that their master boiler makers were present at the conventions.

On the technical phases of the work of the association, Mr. Bentley expressed the hope that the association in its discussions would be able to throw light on the problem of pitting and corrosion of boilers, which so far has found no solution in the laboratory or in the hands of practical investigators. He outlined the need of apprentices in the shop who would later on be fitted to carry forward the work of the masters of the trade who were retiring. Water treatment and its value in cutting, operating and maintenance expense in bad water districts, quality of material and possible improvements, and the work of the chief inspector of the Bureau of Locomotive Inspection in developing and standardizing the use of water columns, were all commented on in his address.

The president's annual address which followed was mainly devoted to an outline of the duties of members of the association in faithfully attending all sessions of the convention and getting the maximum benefit out of the proceedings to improve methods in their own shops when the convention was concluded.

The reports of the secretary and the treasurer indicated that both the membership and financial conditions of the association were showing a healthy growth, with few resignations.

A communication from Hon. Herbert Hoover, secretary of the Department of Commerce, was read by the secretary asking for the co-operation of the association in improving the movement of coal during the summer and early fall months of the year. A memorandum promising the co-operation requested to the best of the ability of the members in their capacities in the maintenance of motive power of the country is to be prepared and forwarded to Mr. Hoover.

An invitation to send a representative to sit in on the Advisory Council of the Federated American Engineering Societies is being acted on by the executive board of the association.

After the conduct of routine business, the first session closed with the discussion of the advisability of the association putting in code form for suggested use of the members and as their best advice on boiler methods, certain methods that have been developed in boiler work that are amenable to such codification. Three subjects suggested for early action were autogenous welding; how and where it should be used, and what tools and methods can best be adopted as standard in locomotive boiler work; flue welding and the proper methods of applying flues, and methods of staying crown sheets.

E. W. Young
President

Frank Gray
1st Vice President

Harry D. Vought
Secretary

W. H. Laughridge
Treasurer

The Wednesday session opened with an address by J. E. Bjorkholm, assistant superintendent motive power, Chicago, Milwaukee & St. Paul, in which he emphasized the duty of every railroad officer to improve service with safety. In this the boiler maker has a most important duty, the promotion of safety through proper maintenance. Boilers are sometimes responsible for engine failures, but their number is fast decreasing. Clean boilers are safe boilers and the importance of keeping them free from scale and mud cannot be too strongly stated. No locomotive is usable unless boilers are in proper condition and officials are beginning to recognize the importance of boiler makers in maintaining service.

John Purcell, assistant to the vice-president in charge of operations of the Atchison, Topeka & Santa Fe Railroad opened the session on Thursday with an address in which he stated that he had gained the impression during his career that the construction, inspection and maintenance of the locomotive boiler is more important than the machinery parts. The expansion and contraction forces caused by the difference in temperature cannot be held and provision for their free movement must be made by giving them all the flexibility of staying and bracing it is practicable to allow. He also dwelt on the importance of maintaining as nearly as practicable, equal temperatures in all parts of a boiler at all times. The importance of an efficient and highly trained staff of boiler inspectors cannot be over-stressed. Those in the larger roundhouses have the very best opportunity to cultivate and develop their powers of observation and judgment in their work, each case investigated broadens their experience and strengthens the judgment which fits them for further responsibility. In other words, Mr. Purcell said, by constant practice in locating defects, carefully looking for the cause, and devising ways to correct them, a man soon qualifies himself as an authority on such matters and increases his value to his employer and himself.

The Friday morning session opened with a most interesting and instructive talk by W. J. Tollerton, general superintendent of motive power, Chicago, Rock Island & Pacific.

Officers Elected for the Coming Year

The following officers were elected for the coming year: President, Frank Gray, C. & A.; first vice-president, Thomas F. Powers, C. & N. W.; second vice-president, John F. Raps, I. C.; third vice-president, W. J. Murphy, Penn.; fourth vice-president, S. M. Carrol, C. & O.; secretary, H. D. Vought, New York; treasurer, W. H. Laughridge, Hocking Valley.

Abstracts of some of the reports and papers presented at meetings of the convention follow.

The Application of Thermic Syphons

The committee investigating this subject reported that the application of thermic syphons increases the life of firebox sheets and flues, basing its belief on the following facts:

By the application and use of thermic syphons a very active circulation of the boiler water is set up and maintained. The circulation, sweeping all parts of the boiler, tends to equalize or reduce the range of temperatures of the boiler parts which would be exposed without thermic syphons. This in turn reduces the stresses that are accountable for cracks, leaks and heavy maintenance expenses.

Many reports were received showing a reduction in boiler work in general repairs, when the locomotive was syphon equipped, as compared with non-syphon equipped locomotives of the same class and service. The committee is also of the opinion that the thermic syphons will be a great help to the crown sheet as they cause a fountain action of the water on this sheet and prevent it becoming overheated. The committee expressed the opinion that the thermic syphon also acts as a substantial support for the crown sheet in cases of emergency. Syphon equipped locomotives have successfully passed through low water accidents. The unusual shape of the overheated area clearly proves that the water continued to flow over the crown sheet after the water protection had ceased.

The following extract from circular No. 260 of December 12, 1923, issued by A. G. Pack, chief of the Interstate Commerce Commission, Bureau of Locomotive Inspection, Washington, D. C., was offered to substantiate their findings:

"We are receiving many alteration reports from a number of different carriers showing the application of thermic syphons and, so far as it has been brought to my attention, there has nothing yet been developed which would indicate a reason why their use should not be extended. They add materially to the direct or firebox heating surface and improve water circulation, which is essential to economical and successful boiler operation, and will deliver a certain amount of water to the crown sheet after it has become below this level, which may obviate what otherwise might become a serious explosion with fatal results.

"Syphons also add some beam and brace support to the crown sheet—they being attached to the crown sheet and at the throat sheet—which may prevent the crown sheet from coming down with a crash in case of low water."

This report was submitted by the following committee: A. F. Stiglmeier (N. Y. C.), chairman; Henry J. Rapps (I. C.), John J. Keogh (C. R. I. & P.); H. J. Wandberg (C. M. & St. P.) and A. C. Dittrich (M. St. P. & S. S. M.)

Autogenous Welding and Its Uses

Autogenous welding is used in boiler, blacksmith and machine shops, ship yards, factories; also by sheet metal workers and pipe fitters for new work and repair work in various branches of the metal trades.

During recent years many and improved devices have been placed on the market, which enables the work to be done with greater efficiency. New alloys have been developed for welding rods and electrodes, which enable the operators to perform autogenous welding with greater efficiency. But we must not lose sight of the fact that before a welder may perform autogenous welding in fireboxes, he, like other mechanics, must have a knowledge of the tools he uses and must also learn to properly heat and make perfect fusion of metals continuously by his control and manipulating of the welding blow pipes, filling rods and electrodes used for the purpose: he should be required to make a test weld of at least 75 per cent efficiency from the original stock of steel used in fireboxes. He should be required to make at least one welded specimen monthly. By so doing, the master boilermakers and the railroad companies may know the efficiency of the welder performing the work, and the man having the highest efficiency is undoubtedly the man whose work will show the best results.

The success of a welding job depends a great deal on how it is prepared, and for this reason the autogenous welder and boilermaker should see that the plates are properly bevelled and edges thoroughly cleaned from dirt, scale and grease. Plates should be secured in position with suitable strut belts, clamps or wedges, with the proper opening to enable the autogenous welder to perform the welding all the way through the plate and make the weld solid.

Autogenous welding is now used in many ways to advantage for the following reasons:

Its application is better known and becoming more efficient.

The cost of application in many instances is less.

In many cases the use of the process reduces the cost of maintenance to the locomotive firebox and other parts.

There is a saving in the operation of the locomotive.

When the flues are welded in back flue sheets, there are less leaks, therefore, a better steaming boiler. When there is a good steaming boiler, there is a fuel saving locomotive. When there are less leaks, there are not as many locomotive failures, therefore, less delays and a reduction in operating costs.

For further advancement of the process, it is essential that all operations be given careful consideration and study, which is so necessary for the further development and advancement of the autogenous welding processes.

This report was prepared by a committee composed of H. H. Service, chairman; R. W. Clark, Isaac J. Pool, G. M. Wilson and J. L. Wells.

[Abstracts of other papers will appear in later issues.—EDITOR.]

Reclamation of Angle Cocks

By A. Skinner

Air Brake Foreman, A. T. & S. F., Corwith, Ill.

A LARGE number of angle and cut out cocks are constantly being received at the reclamation yard with worn threads on the brake pipe end. It became necessary to devise other means of reclamation than that of the drill press which was too slow and required too much handling in order to take care of all that were coming in. As a result a 14-in. Warner & Swasey turret lathe was added to the shop equipment and the writer decided to try the work of

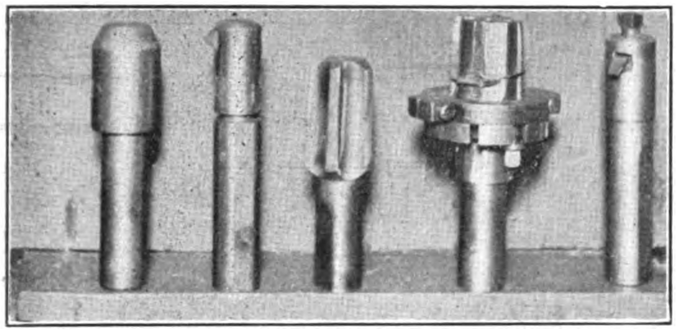


Fig. 1.—Set of Tools Used on the Turret Head

boring and tapping the angle cocks on this machine. A bracket for the lathe screw and the necessary tools to fit in the turret head were made and after lining up the lathe and trying out a few cocks the results were quite gratifying. It was found that five complete operations could be performed in the same time that was formerly required for one operation with a drill press.

The actual time to complete the five operations was four

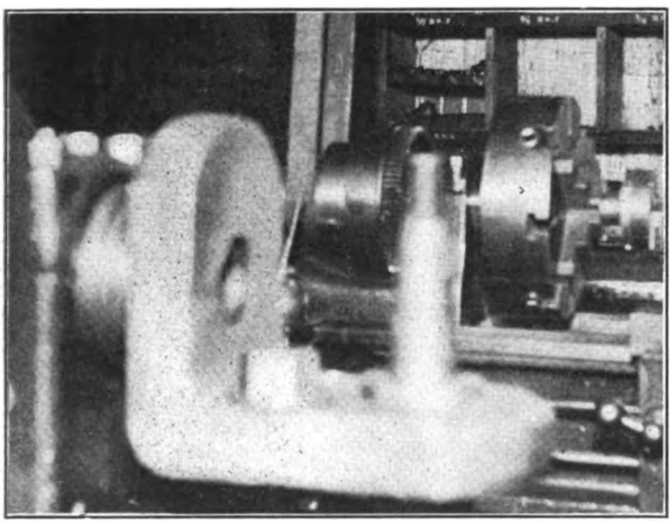


Fig. 2.—Bracket for Holding the Angle Cock on the Lathe Screw

minutes, but this tended to crowd the lathe so we are satisfied to limit production to 100 cocks in eight hours.

The tools used on the turret head are shown in Fig. 1. Reading from left to right, the set consists of a centering tool, a boring tool, a reamer, a Burrit pipe tap with removable chasers and a counterboring tool. Fig. 2 shows the bracket for holding the angle cock on the lathe screw. This device is simple in construction and is provided with a bolt tapered to fit the angle cock body as shown in Fig. 3.

In addition to boring and tapping angle and cut out cocks, the standard self locking handle, P.C. 20128, is also reclaimed. New keys are fitted where necessary and by so doing many cocks are put back into service that would otherwise be scrapped. No cocks are scrapped unless they are broken and beyond repair. The test is as rigid as it can

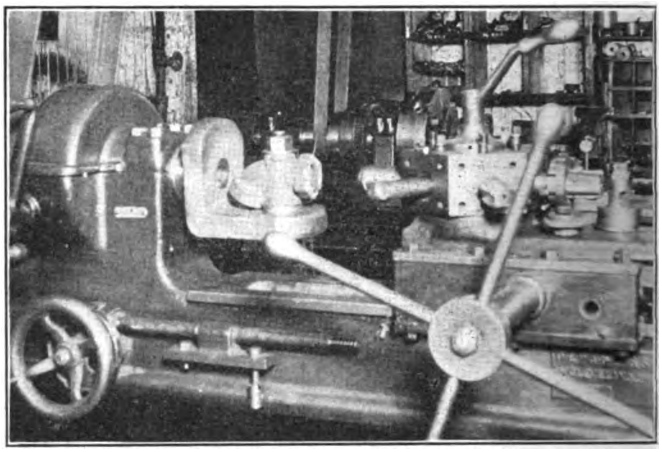


Fig. 3.—Angle Cock in Position to Receive the Centering Tool

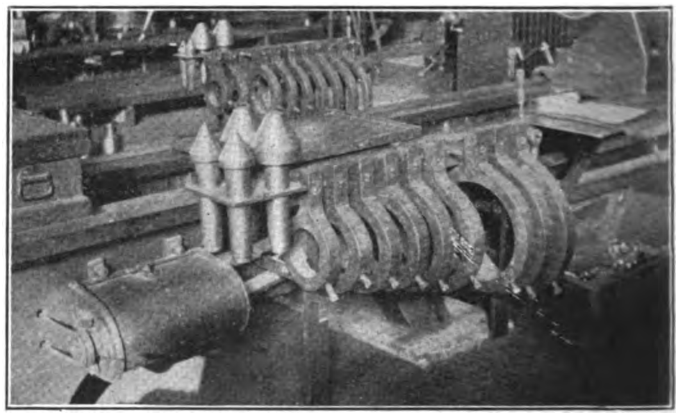
be made. Every cock receives individual attention and must come up to standard before being returned to service.

A Rack for Holding Lathe Dogs

By J. Robert Phelps

Apprentice Instructor, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

THE usual method of taking care of lathe dogs in a machine shop is to pile them in an out-of-the-way corner or throw them on the floor where they are covered with an accumulation of oil and dirt. They also interfere with the floor sweeper as he has to move them from one place to the other in the performance of his duties. The illustration



A Rack for Holding Lathe Dogs and Lathe Centers

shows a device that is being used in the machine shops of the Atchison, Topeka & Santa Fe at San Bernardino, Cal., which keeps the lathe dogs and centers up off the floor and within convenient reach of the operator.

Lathe centers are considered one of the most important things about a lathe. By keeping the extra centers out in plain view they will not get chipped or damaged so readily as they do when they are either on the floor or put away in a drawer with other tools. The foreman can see them at all times, which enables him to keep a check on his men so that they will have the various sizes of centers in condition to be ready for use to take care of any emergency job that may come in. This arrangement is especially recommended for lathes handling axles and crank pins which require a wide range of sizes of dogs and centers.

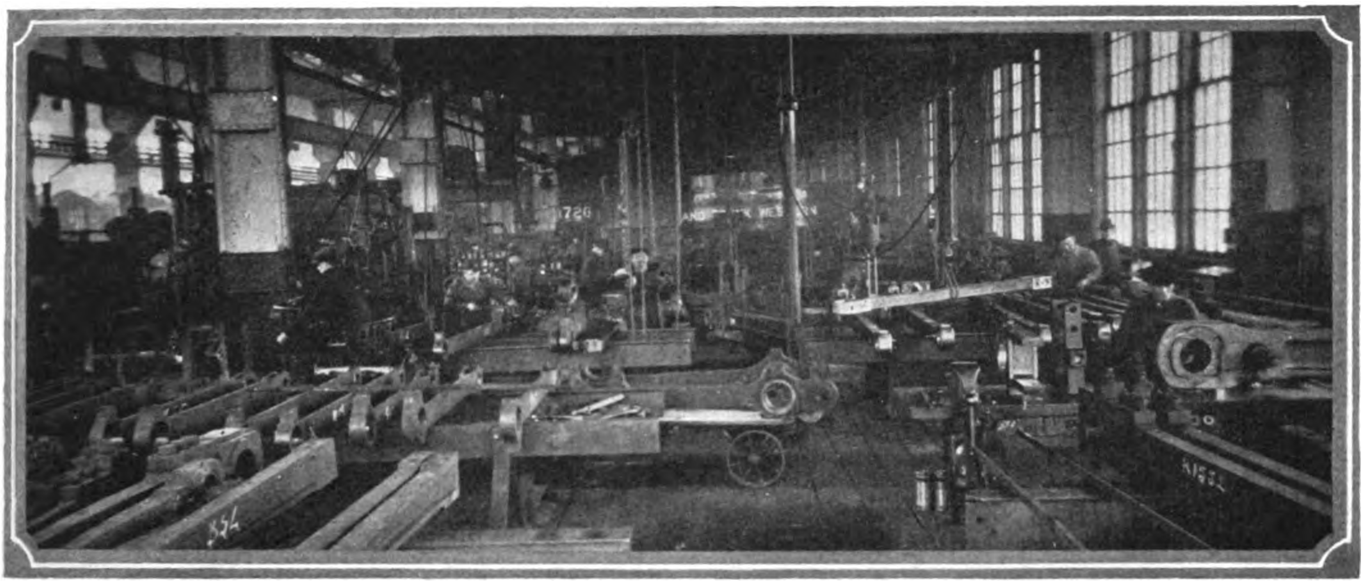


Fig. 1—General View of the Rod Department

Handling Rod Work at Battle Creek Shops

Prize Winning Article Submitted in Rod Job Competition—Methods Are Constantly Being Improved

By M. H. Westbrook
Shop Superintendent, Grand Trunk, Battle Creek, Mich.

THE rod repair department at the Grand Trunk shops, Battle Creek, Mich., is equipped and laid out to take care of a 22-pit repair shop, handling all the classified repairs to 334 locomotives, including many of the U. S. R. A. Mikado type, and meeting the requirements of eight roundhouses from which rods are sent to be overhauled or renewed. This department is located under a balcony, as shown in Figs. 1 and 2 which also indicate passages for the gasoline tractor while delivering rods to and from the department. The balcony provides a convenient support for the overhead runway and crane which serves all the benches and heavy machines.

Each Man Handles Special Work

As far as possible, each man is assigned to a certain specified part of the work on the bench as well as on the machines. Thus one man devotes his time entirely to main rod work and others to the side rods. These rods are all carefully trammed as soon as stripped and any distortion or lengthening that may have taken place is corrected, so that the bushings are always bored out concentric and each rod is sent out conforming exactly to standard fixed trams, which are compared to a master gage block each week.

Main rod bolts are kept in stock in the bolt department, rough turned and threaded, the final fit being made as required on a lathe in the rod department situated close to the main rod benches. Knuckle pins at present are being made on an engine lathe, but it is proposed to manufacture these on a turret lathe which is now on order and will be located in the bolt and pin manufacturing department.

All engines are stripped on a special pit, the rod foreman always being present when rods are being removed to check up on reports previously received from the roundhouse inspectors. The rods are then loaded on a trailer and hauled by tractor to the cleaning vat, as shown in Fig. 3 and immersed, with other motion work, in a solution of metal cleaner compound, six ounces to the gallon, and boiled for about two hours. After removal they are rinsed off in the draining bowl located behind the vat and connected to the sewer.

From this vat they are delivered on trailers to the rod department and are then whitewashed with the by-product of the acetylene generating plant. After drying, they are hammered with a five pound copper hammer and carefully inspected for cracks or other defects.

The Condition of Crank Pins Important

As so much of the life of the rods, brasses, etc., depends on the condition of the crank pins and journals, I must digress here for a moment to explain that before any extensive repairs to the rods are commenced, the crank pins are carefully inspected to determine whether they are circular, parallel and in quarter, it being frequently found that a crank pin may be circular and parallel and yet worn very much out of its original quartering. In this case, they are trued up by the two portable crank pin turning machines shown in Fig. 4, one of which is designed for turning pins having threaded ends and the other for pins used in connection with Walschaert gear. Both of these machines are well advertised devices and a very much worn main pin can be turned with either machine in from two to two and one-half hours, inclusive of the time of setting up and removing them.

When crank pins are worn down to the limit of permissible wear, they are, of course, renewed. I wish to emphasize here the necessity of great attention being paid to the condition of crank pins. In some modern shops this is neglected and I have seen men engaged in trying to file the pins true and

round. This is practically an impossibility and what is done with the file usually takes more time than would be required to true the pins accurately with the portable machines.

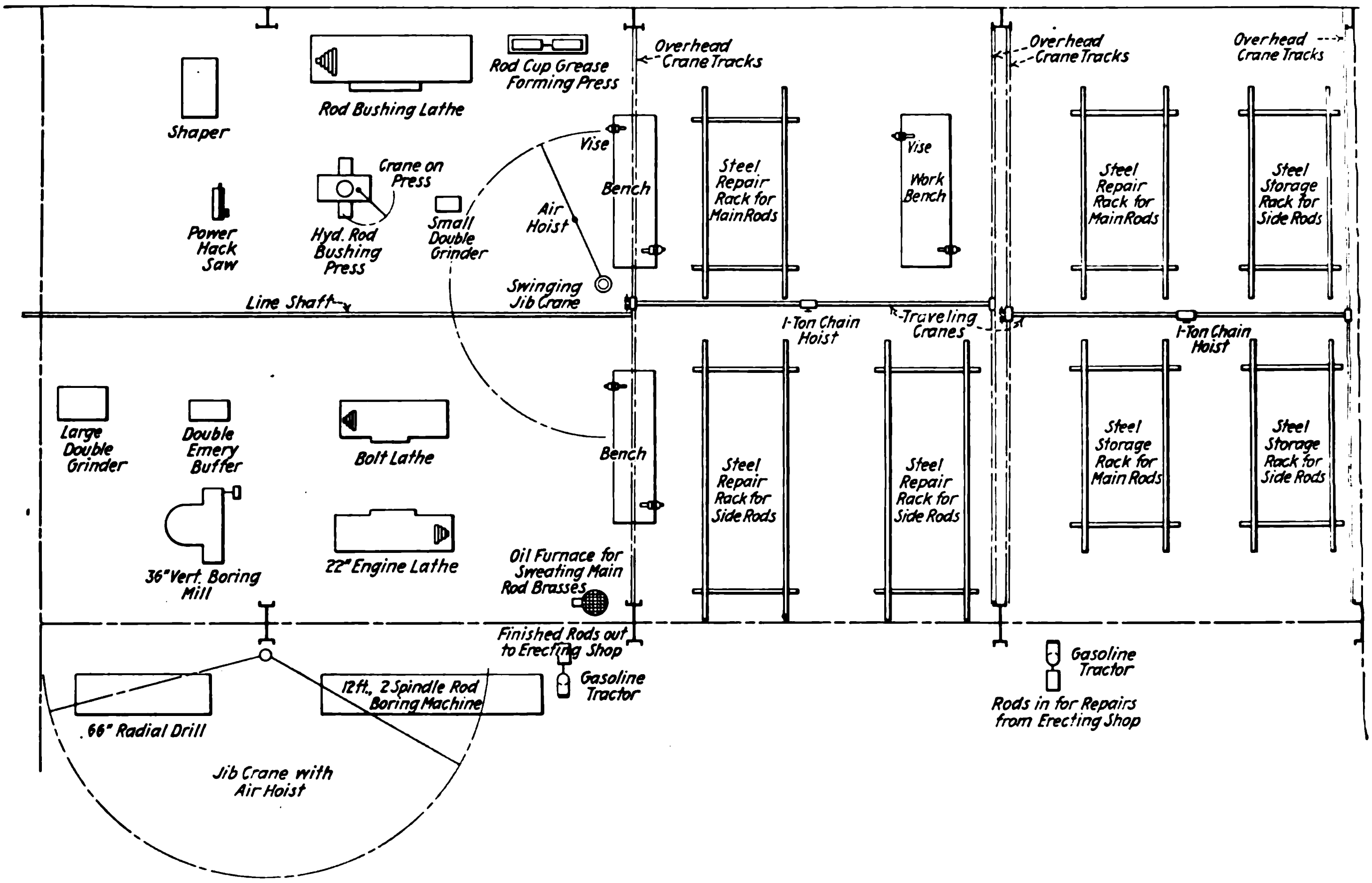


Fig. 2—Plan of Rod Department, Showing Machine Layout, Cranes, Work Benches, Repair Racks and Storage Racks

All new rods are manufactured on a store order in the forge shop from steel billets of the following specifications:

	Per cent
Carbon	0.38 to 0.52
Manganese	0.40 to 0.60
Phosphorus, maximum	0.045
Sulphur, maximum	0.05

They are thoroughly annealed, taking from 48 to 60 hours in the process. Systematic heat treatment of all rods as they

Fig. 3—Tractor and Trailer Used for Handling Rods to and from the Cleaning Vat

are removed when in for repairs has not as yet been adopted, although the matter is being investigated.

The large number of new side rods usually found in the course of manufacture in many of the railroad shops visited is most noticeable and possibly, if a special investigation were made as to the cause for this, the number could be somewhat reduced. The comparatively small number of new rods required of the rod department at Battle Creek shops is attributed solely to the special care being paid to the condition

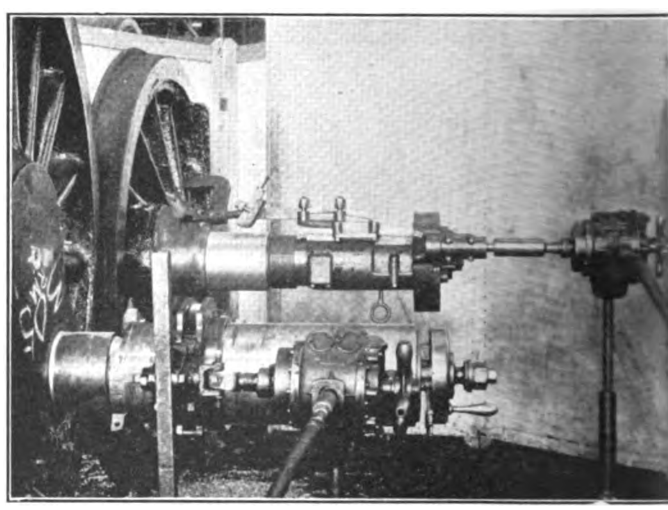


Fig. 4—Portable Machines for Turning Mounted Crank Pins

of crank pins, journals, shoes, wedges, frame jaws and driving boxes.

After the crank pins have been cleaned off, inspected and the necessary reconditioning or renewals completed, the mechanic whose duty it is to perform this work, records the sizes on the 9 in. by 12 in. form shown in Fig. 5—credit for which is given the Beech Grove shops of the Big Four. This

form is sent to the foreman of the rod department and contains all the instructions the machine men require in connection with the bushings and brasses, making it unnecessary for them to go to the wheels, wherever they may be located, to get their sizes. The machines are thereby kept in more contin-

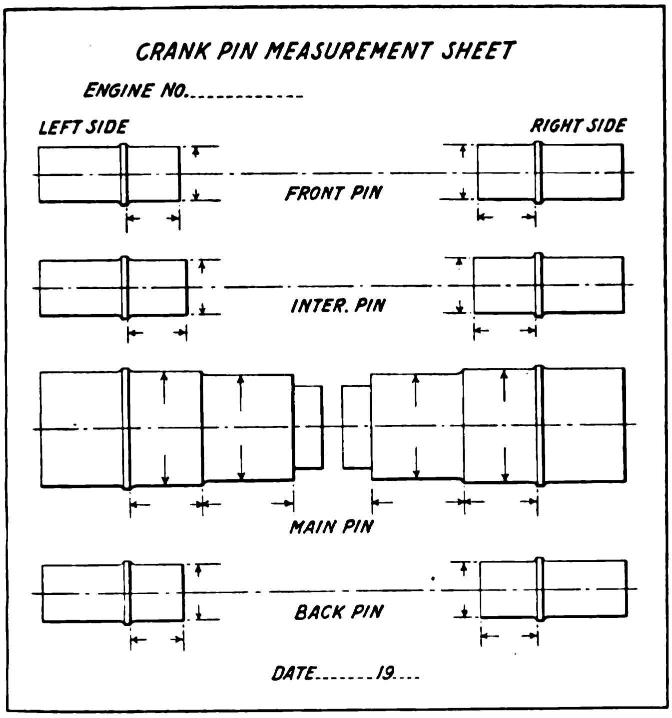


Fig. 5—Form for Recording the Sizes of Crank Pins

uous operation than if the men had to leave them to obtain these sizes.

All bushings are removed and applied by a motor-driven hydraulic press. All rods are then distributed to the various benches shown in Fig. 1, which are made from 4-in. by ½-in. iron bolted to old sections of 16-in. I-beams split lengthwise in two pieces. The legs are made straight on one side for

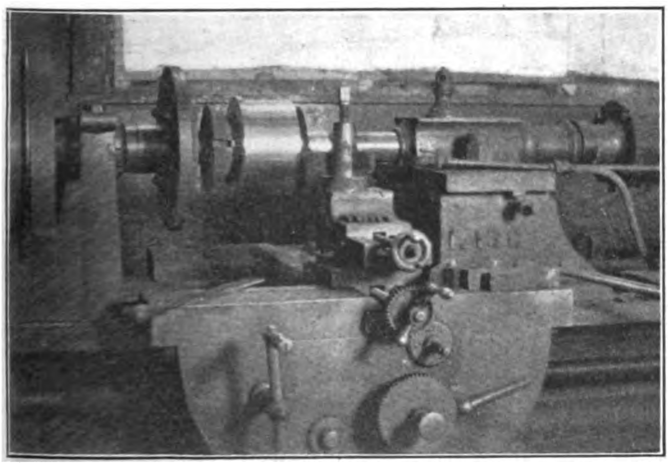


Fig. 6—Air-Operated Arbor for Holding Rod Bushings in Engine Lathe

greater convenience of men working at the benches, and are bolted to the floor.

Most of the bushings are turned on the specially designed arbor* shown in Fig. 6, fitted to an old engine lathe and operated by an air cylinder and piston which takes the place of the tail stock screw and hand wheel. This arbor is bolted

*Credit for this arbor, with the exception of the air cylinder which was added here, is due the Chicago & North Western shops at Chicago.

to the face plate. It is provided with three blades fitted to angular grooves in the stationary member. Each blade has three steps which are designed to take in every size of bushing used. As air is applied, the blades are forced outwards along the angular slots and hold the bushing while being turned and faced to length by specially shaped tools. It has been found that better time can be made using this device than turning them in the boring mill. A special tool block arranged to hold three tools, one to be used for turning and the others for facing to length, will soon replace the single

Fig. 7—A 36-In. Boring Mill Used on Rod Work

tool holder shown in illustration, merely being an improvement not yet completed.

The 36-in. boring mill shown in Fig. 7 is used for turning bushings when the lathe has more than can be handled in the required time and occasionally for boring main rod brasses

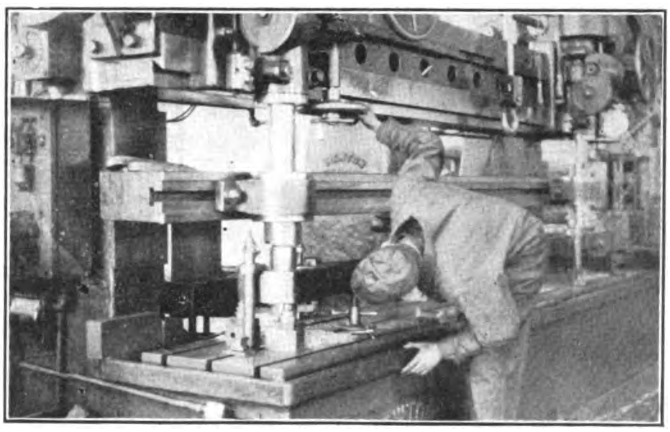


Fig. 8—Adjusting the Cutter on a Modern Two-Spindle Rod Borer

as shown for outstations. All boring of main and side rod brasses and bushings is performed on the two-spindle rod boring machine shown in Fig. 8. We graduated the cross rail of this machine to correspond to the various lengths of our rods, attaching an indicator to each head, thereby providing a

double check on the lengths of rods and ensuring the greatest accuracy in maintaining them to the correct standard lengths.

Two-Spindle Rod Borer Saves Time

Prior to the purchase of a modern two-spindle rod borer, this work was handled on an older type machine and while fairly satisfactory results were obtained, the difficulty encountered in correctly aligning the rods for boring on the machine caused considerable delay or inaccuracy or both. The installation of the machine shown in Fig. 8 is one illustration of many things which have been done to "organize and improve the rod department."

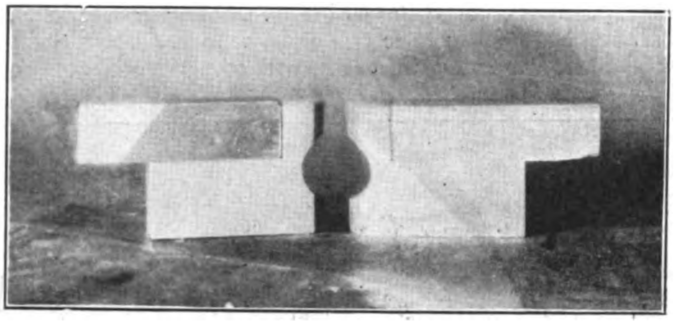


Fig. 9—Short One-Inch Square Tools Are Inserted in Worn Davis Cutters

Fig. 10—Bushing Keyways Are Cut on a Shaper

Both ends of the main rods are bored with special Davis boring bars and faced on both sides with one setting, a long one-inch square facing tool, ground to under-cut from the bottom, being loosely inserted from underneath and fed upward the required amount. This makes a first class job, and saves an extra setting. The whole operation is frequently completed, floor to floor, in one hour. Fig. 9 shows how a considerable saving of cutters was effected by utilizing short one-inch square tools inserted loosely in worn down Davis cutters. The method of cutting keyways in the bushings is shown in Fig. 10.

We have experimented with various tools for the removal of the solid cores from new rods but must admit that so far we do a quicker job by first drilling a pilot hole in the center of the rod and using a series of double end cutters, ground especially for cutting steel. The piece is bored out from the solid rather than by using what is known as cat-head cutters or hollow mills which in some shops are said to successfully remove the solid piece.

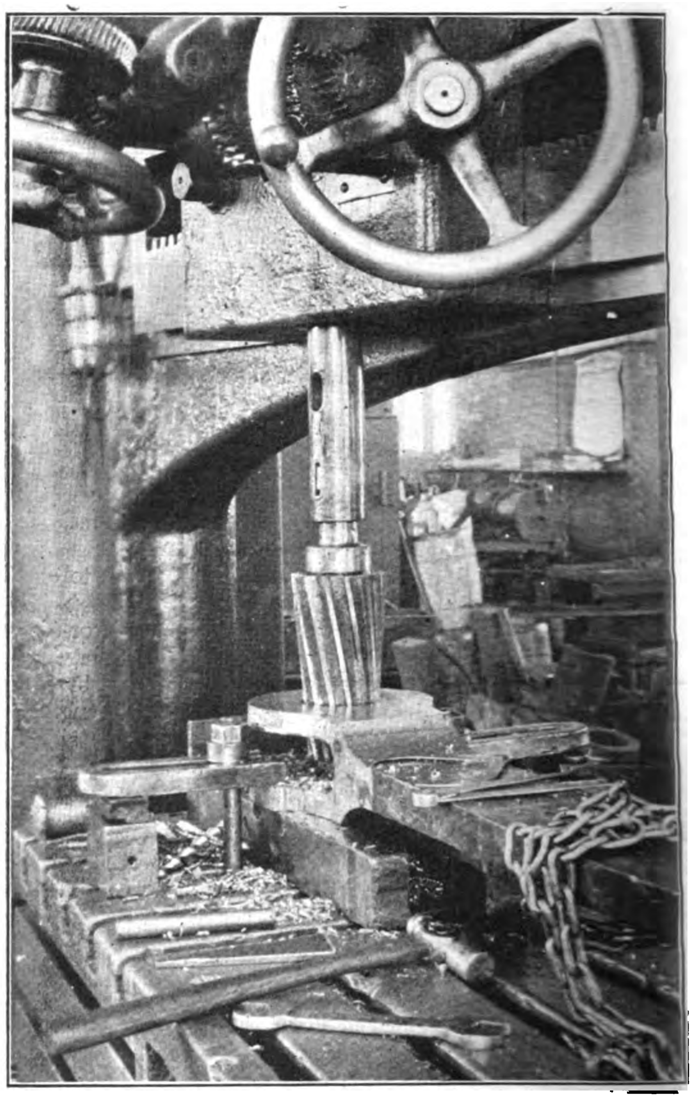


Fig. 11—Reaming Side Rod Knuckle Pin Hole

Reaming the bolt holes for big end straps is performed in a most satisfactory manner on a radial drill. By the use of the left-hand, hot-twisted, four-fluted reamers, wonderful results are obtained. These reamers are operated at a speed of 55 ft. per minute, or approximately 140 r.p.m., using a hand feed much coarser than the automatic feed of the machine is capable of taking.

With the 8 or 10-fluted reamers generally used for this operation, the operator is frequently obliged to withdraw them from the hole to clear the chips, and often through fear of breaking the reamer, uses a finer feed than necessary. The reamer described has plenty of chip room and consequently

will work successfully at high speed and coarse feeds. It is unnecessary to remove the reamer at all, when once started, to clear the cuttings from the flutes. It has also been found that a good soluble oil coolant, costing from three to five cents per gallon, makes as good a hole for this operation as the best high priced cutting oil.

Machining the main strap fit on the brasses is performed on a slotter with a special indexing angle plate and arbor combined. The average time on this is approximately one and one-half hours each. I believe this is being done in some shops in less time on a milling machine, but so far we have not been able to get milling cutters to stand up on the bronze used in these castings, although experiments are being continued.

Fig. 12—Operation of Sweating Main Rod Brasses Together

Attention Given to Knuckle Pin Holes

The knuckle pin holes are reamed out as shown in Fig. 11 and on the same machine used in reaming the main rod bolt holes, the left hand spiral reamer, with liberal chip room, being found the most suitable tool. These reamers are all bored out to fit a standard driving spindle having a threaded end and are held in place by a nut.

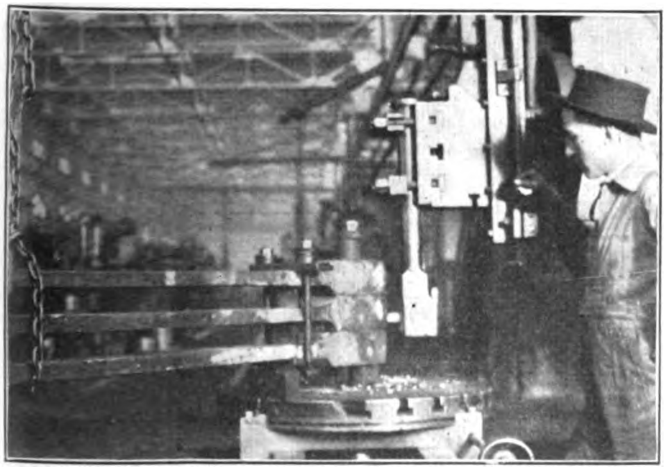


Fig. 13—Slotting Three New Rod Ends at the Same Time

Brasses are sweated together at an oil furnace as shown in Fig 12. Experiments are now being conducted with a lead bath for heating these brasses, as we do not believe the method now used to be the most efficient.

Ends of new rods are machined as shown in Fig. 13, using the same machine as is used for slotting the brasses. While it is said that a heavy vertical milling machine performs this operation very quickly, a machine of this type not being available, the method shown makes a very quick and creditable job.

Various methods are used in cutting out the fork ends. Among them the writer has seen a two-inch hole drilled through the end of the desired slot, then machined out to size on the slotter; he has seen the rod drilled for clearance and twin saws used to cut out the piece, after which it is finished on a slotter. Either of these methods takes from 4 to 6½ hours per rod. By the method shown in Fig. 14, this whole operation can be completed from floor to floor in a half hour.

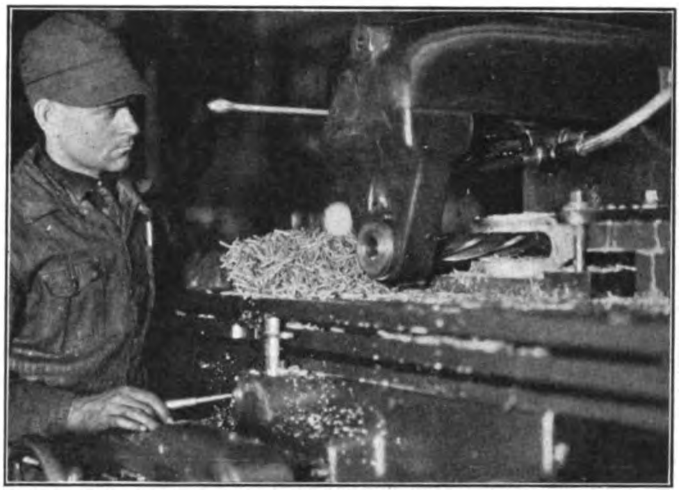


Fig. 14—Side Rod Fork Ends Are Cut Out on a Vertical Knee-Type Milling Machine

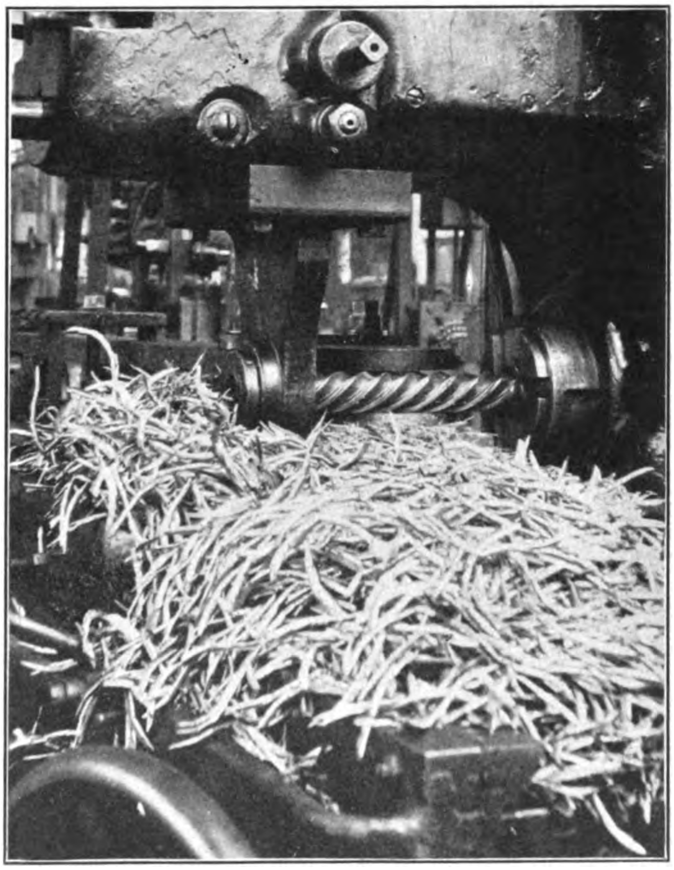


Fig. 15—This Cutter Which Cut Very Freely, Would Not Stand the Feed

It may be of interest to describe here some results obtained

while experimenting with special milling cutters for this operation. Fig. 15 shows a form of cutter which gave excellent results. It was very free cutting, but broke too easily when forced to a feed of ¾ in. per minute. Possibly this was the fault of our tempering process or of insufficient chip room.

We intend to continue experimenting with various forms of

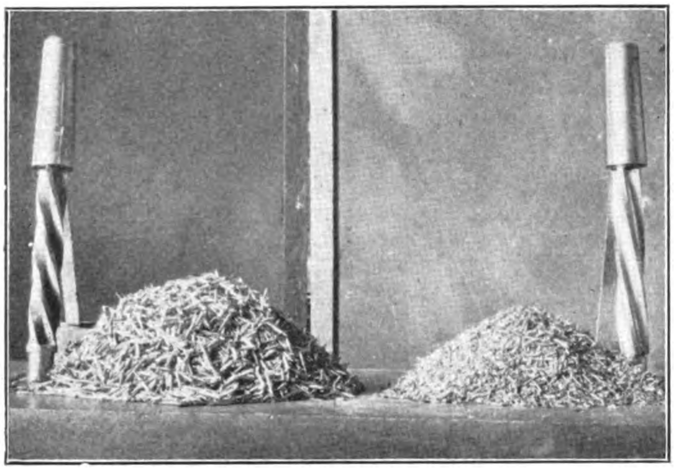


Fig. 16—Pictorial Proof of the Importance of Correct Spiral and Cutter Tooth Form

cutters for this operation, but have not sufficient call for these rods to permit extensive tests. It is suggested that some of the larger shops pursue this interesting feature and publish the results obtained in the *Railway Mechanical Engineer.*

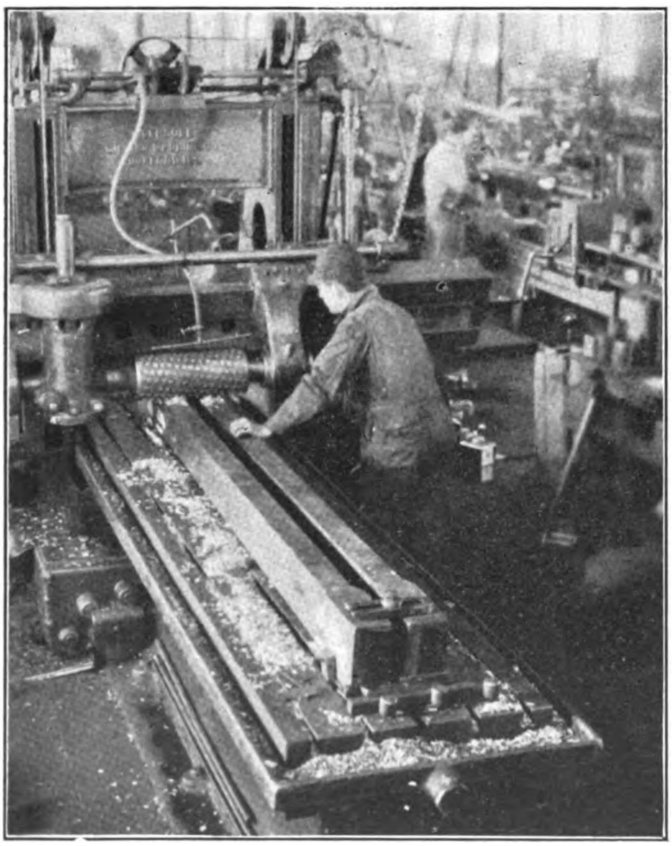


Fig. 17—New Rods Are Machined on a Slab Miller

Fig. 14 shows the best form of cutter so far developed. This was made by converting a taper locomotive reamer used in reaming main rods. This reamer was ground parallel, cut off to the required length, the outer end built up with bronze by the acetylene process and turned to fit the overhanging arm of the milling machine. This tool has cut several fork ends out of the solid in an actual cutting time of less than 15 minutes and is in about as good condition as when first started. It is 2 1/32 in. diameter and while it retains that size but one cut is necessary. After it is ground it will, of course, be necessary to take a second cut, which can be done at a greatly increased feed. These reamers are made from a special rolled section of high speed steel and twisted while hot, which very probably accounts for their strength and durability. A heavy, continuous flood of good coolant is necessary to get good results or make fast time on this operation.

Fig. 16 shows an interesting comparison of the cuttings obtained from two cutters, each doing the same amount of work on two rods made from the same billet at the same time and annealed together. The cutter to the left is that shown in Fig. 14 milling out the fork end of the rod, the one on the right was made slightly heavier and with a somewhat different spiral angle. The cuttings in each pile weigh the same but those made with the cutter on the left are much more loosely curled and at a feed of ¾ in. per minute it went along without difficulty, making a fine curly chip which it was a pleasure to watch rolling out. The other was in frequent difficulty and the feed had to be released occasionally for a few moments for fear of breaking the cutter.

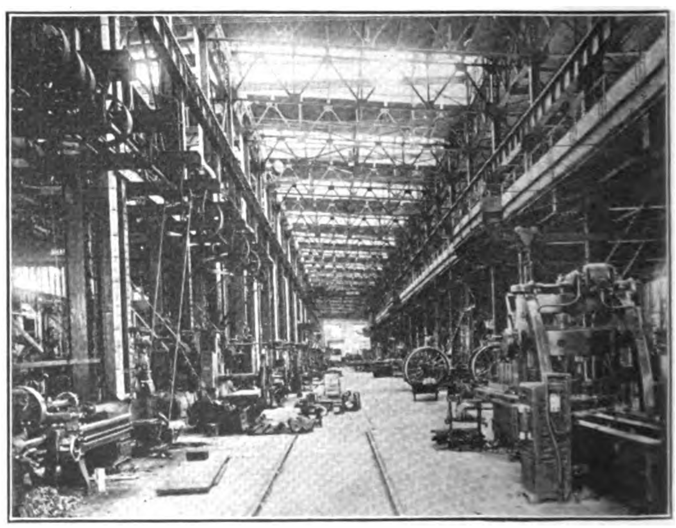
New Rods Milled in Pairs

Because machines used in the manufacture of new rods are employed on this special class of work only a small part of the time, they were not located in the rod department but in a centralized general manufacturing department where the full time of such machine tools may profitably be utilized in other lines of work.

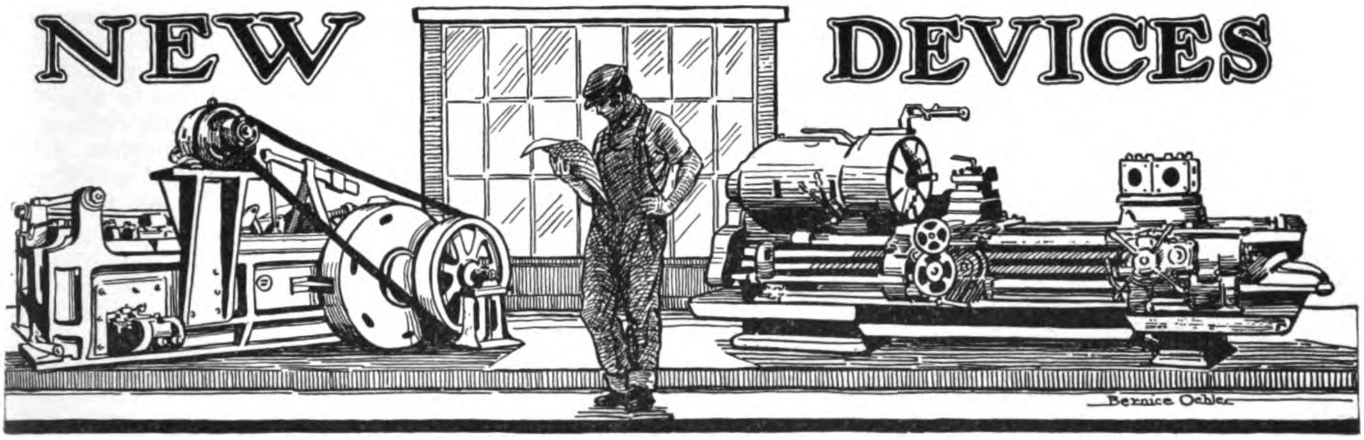
Fig. 17 shows a pair of main rods in the course of manufacture. They are milled in pairs wherever possible. Larger shops would no doubt prefer a larger machine but the writer has found it quite possible to equip a shop with larger tools than can be used to the best all round advantage, which of course cannot be properly discussed in this article.

The rod work is of course scheduled along with other work required on the locomotives under repair. A full account of the scheduling system appeared in the August, 1923, issue.

This article may not describe the best rod department in the country, but at least it is one that is doing good work and what good features it has are the development of suggestions made by various men and foremen, all of whom are interested in having their departments efficient.



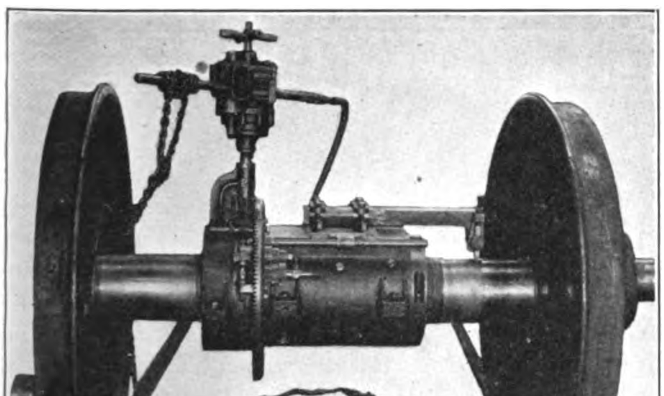
Interior View of the Machine Shop at the Billerica, Mass., Terminal of the Boston and Maine



Marsh Portable Journal-Turning Machine

MANNING, MAXWELL & MOORE, INC., New York, is offering the Marsh portable journal turning machine, which is designed to true up journals on the driving wheel axles of a locomotive without having entirely to remove the drivers from under the locomotive. It is intended primarily for the use in roundhouse for quick repairs. It can also be used in erecting shops for truing up journals on driving wheel axles in cases where new tires are applied to the wheels in the erecting shop and where it is desired to relieve the driving wheel lathe of the journal work.

The machine consists of two principal parts; namely, the stationary or inner sleeve which is provided with a suitable clamping mechanism for attaching it firmly on the central part of the axle, and the outer or revolving sleeve which rotates on a bearing on the inner sleeve and supports the carriage for the cutting tool and the feed mechanism. The inner sleeve has four tee slots cut longitudinally in its inner circumference and spaced equally around the circumference. Four wedges are fitted in these slots, and by moving them in the slots the sleeve is clamped or unclamped from the axle. The heads of the wedges are slotted to fit in a circular groove in a single large nut in one end of the inner sleeve so that revolving the nut moves all four wedges backward and forward in their slots in the inner sleeve at the same time. This arrangement provides a universal chucking action and insures the sleeve always being exactly centered on the axle. To provide for clamping the sleeve to axles smaller than the usual capacity of the machine, four steel strips of the same thickness are attached to the wedges by two screws each.



Journal Turning Machine Which Can Be Applied Without Removing the Wheels from the Locomotive

The outer or revolving sleeve is driven by a large bevel gear through a pinion by an air motor fitted on a taper shank, or by an electric motor through belt and pulley. The tool carriage operates on a dovetail type bearing running longitudinally on the sleeve; it is very similar to a lathe carriage.

The tool bar is a steel forging 2 in. square and is held by two screw clamps on top of the carriage. The bar is made of sufficient length to enable the machine to turn journals up to 14 in. in length. The tool holder on the end of the bar is of the swivelling type to enable the tool to get into the close corners next to the hub liner. Provision is also made for feeding the tool down into the work by means of a screw above the tool, which is provided with a lock nut.

The tool carriage is driven by a lead screw operating in a bronze nut on one side of the carriage. The lead screw is driven through a series of spur gears which are attached to the side of the main bevel drive gear. On the end of the lead screw next to this large bevel gear is a small spur gear which meshes with the larger of three spur gears which are loose on their shaft. A sliding key is provided in this shaft to transmit the drive through whichever of the gears it is desired to use. Thus are provided three changes of feed. This shaft extends through a bearing in the web of the large bevel drive gear and a small bevel gear is attached to the projecting end. Meshing with this small bevel gear are two other small bevels diametrically opposite each other and loose on a shaft which runs parallel to the web of the large drive gear. A sliding key is provided in this shaft, which enables the feed to be reversed, and by setting the key in neutral position, hand movement of the tool carriage can be accomplished by attaching a wrench to a square head on the back of one of the shafts. Bearings for this shaft are provided on a one-piece bracket attached to the web of the main bevel drive gear. On the end of the shaft opposite the square head is attached a small worm wheel and this wheel meshes in a large steel worm 1¾ in. wide, which is inserted in a circular groove cut in the inner or stationary sleeve of the machine. In operation the feed is provided by moving the small worm wheel over the large worm.

To provide for placing the machine on the axle, both sleeves must be made in halves. To insure getting the halves of each sleeve together in proper alinement a longitudinal tongue and groove arrangement is provided on both the edges which come in contact, and in addition to this the bolts which

hold the two halves together are tapered and fitted very closely so that they act as dowels. The inserted worm wheel of the feed mechanism on the outer sleeve and the nut which operates the clamping wedges on the inner sleeve are also both made in halves.

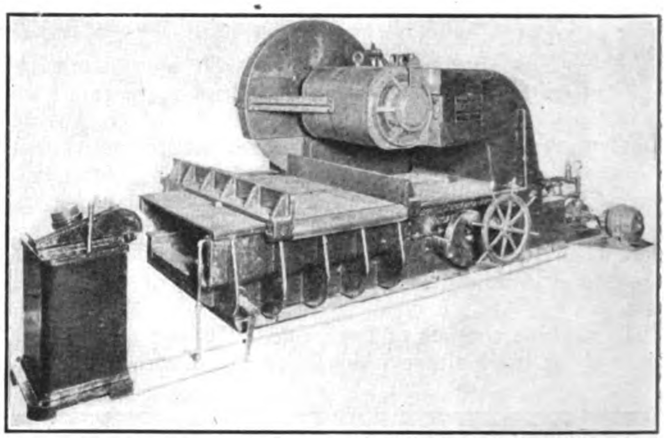
When using the machine in the roundhouse it is only necessary to drop the wheels on which the journals are to be turned far enough below the frame of the locomotive to give the machine room to operate. The wheels can be blocked up and the jack used to hold the lower half of the inner sleeve which must be applied first. With the inner sleeve in place and bolts tight, the clamping wedges can be tightened with a spanner wrench. The outer sleeve can then be applied in the same way and the tool set. It is then only necessary to put on the air motor and begin work. The machine is light enough to enable two men to apply it easily and is sufficiently rigid to enable cuts of 1/8 in. with 1/32 in. feed to be taken without any appreciable chatter.

A Friction Saw Developed for Heavy Duty

JOSEPH T. Ryerson & Son, Inc., Chicago, Ill., has recently added to its line of friction saws a large size which is known as the No. 5. It was developed for heavy duty, and is designed to handle the largest sections rolled. The added capacity of the machine is indicated by the fact that it is driven by a 125-hp. motor, while the largest saw heretofore built by this company is equipped with a 60-hp. motor.

The new saw takes a 61-in. by 3/8-in. blade and the vertical clearance under the hood and flanges is 14 3/4 in. It can handle the maximum size of I-beams, channels, angles, tees and girder rails, 3 1/2-in. square bars and 4-in. round bars. As shown in the illustration, three rollers have been added to the cutting table to facilitate handling the heavier sections.

The saw is controlled by means of two levers mounted on a control box, which may be located where it is most convenient for the operator. One of these levers controls the water supply and the other moves the saw in or out of the cutting table. The feed mechanism consists of both a hand and hydro-electric automatic feed. The control box is equipped with a voltmeter and an ammeter in order to keep the operator aware at all times of the load on the motor.

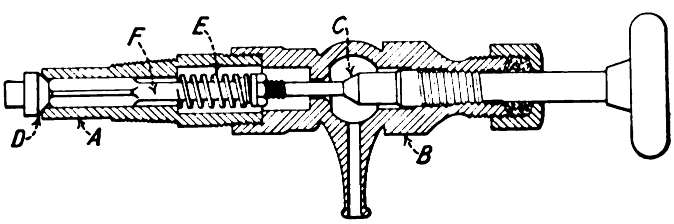


Friction Saw Designed to Cut the Largest Sizes of Channels and Bars

A Gage Cock Permanently Attached to Boiler

THE Buffalo, Rochester & Pittsburgh is using on some of their locomotives a new type of gage cock which was designed and patented by H. C. Vormeng, locomotive inspector on the B. R. & P. at Rochester, N. Y. The principal feature of this gage cock is the ability to grind in the main valve seat without draining the boiler to which the valve is attached.

The drawing illustrates the principle of operation of the gage cock. The inner section of the valve casing *A* is screwed into the boilers and remains permanently in this position. The outer section *B* of the gage cock is screwed in to the protruding end of the inner section *A*. Passing through the two sections of the gage cock is a valve stem containing valve *D* at the extreme end of stem and valve *C* in the valve chamber which communicates with an outlet spout. A coil spring *E* surrounds the outer end of the inner valve stem *F*. Tension applied to the spring by means of the nut and washer as shown. At the extreme inner end of the valve stem are guiding members formed which cause the valve stem to be supported in proper alinement to insure the seating of valves *C* and *D* upon their seats. A study of the illustration will show that by unscrewing the outer section *B* of gage cock from the inner section *A* and likewise disconnecting the inner valve stem *F* the tension of the spring *E* seats the inner valve *D* thereby preventing leakage while the outer valve *C* is removed to be ground.



Valve C Can Be Ground Without Removing the Valve from the Boiler

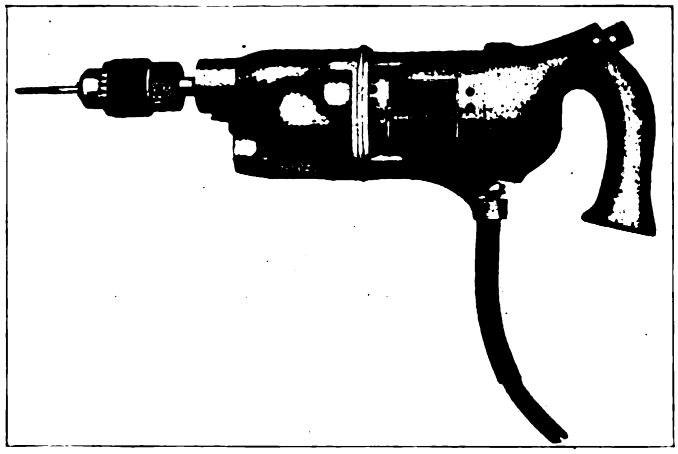
THE TOTAL LENGTH of the world railways, according to the latest figures, now approximates 750,000 miles against about 700,000 miles in 1913, 500,000 in 1900, 400,000 in 1890, 250,000 in 1880 and 25,000 in 1850, these figures being, of course, in very round terms.

Reversible Electric Tapping Machine

A PORTABLE tool for tapping drilled holes, similar in design and appearance to a portable electric drill, has been designed by the Independent Pneumatic Tool Company, Chicago, Ill. It is known as the Thor Reversible Electric Tapping Machine and the size UKR, now being announced, is suitable for tapping holes up to 3/16 in. in diameter and for retapping any size of holes up to 5/16 in. in diameter.

The machine has the same motor as the standard Thor Portable Electric Drill but the speed of the spindle has been reduced to 550 r.p.m. through worm gears which are enclosed in the gear case. The reversing device is mechanical. A slight pressure toward the work will engage the clutch and cause the spindle to rotate toward the right. When the tap has been run in, a pull on the machine immediately reverses the spindle for backing out the tap. It is not necessary to shut off the current between each hole tapped. When no pressure is exerted in either direction, the spindle runs free. The gears may also be locked so that the machine is operative in reverse only.

A universal motor is used so that the machine can be operated on either alternating or direct current circuits of 110 or 220 volts. The weight of the machine is 6¾ lb.

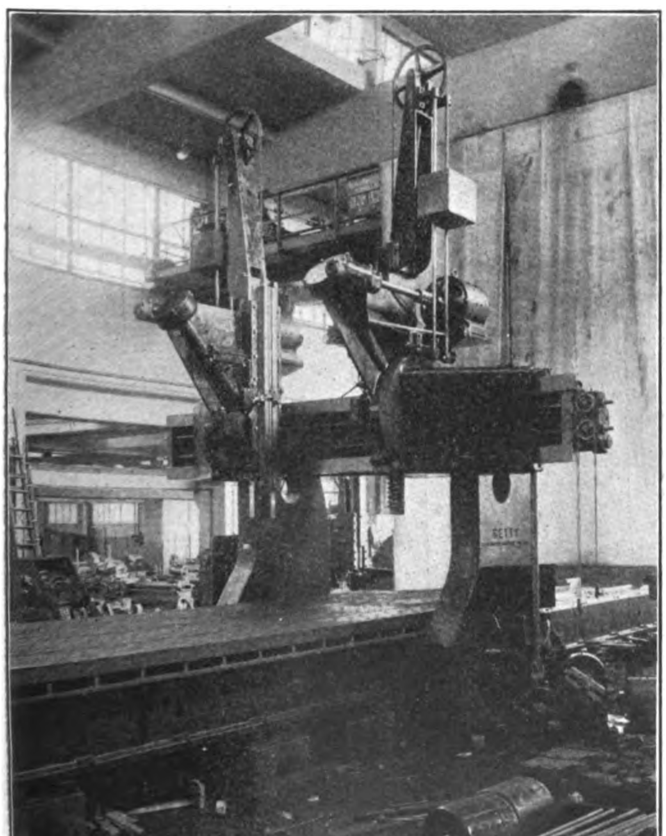


This Machine is Suitable for Tapping Holes up to 3/16 in. Diameter

A Large Special Planer Type Slotter

A LARGE special machine tool of unusual design has recently been built by the Betts Machine Works of the Consolidated Machine Tool Corporation of America. This tool was built for railroad practice and is capable of performing operations on unusually large work.

The bed and table of the machine are of the conventional planer design. The bed has one vee and one flat track for guiding the table, both of which are automatically lubricated by means of oil pockets and rollers. The table has suitable tee slots and stop holes properly spaced for conveniently clamping the work.



A Betts Planer Suitable for Large Work in Railroad Practice

Fastened to the bed are two heavy uprights carrying a fixed crossrail of unusually wide face and deeply arched at the back. The crossrail carries two saddles, which in turn carry the slotting rams and, owing to the fact that provision must be made for angular slotting, these rams face each other. They are carried by swiveling saddles, which makes it possible to slot at a maximum angle of 2 in. with a 12-in. stroke. The saddles are swiveled by means of a worm and segment.

Each ram is driven by a 20-hp. reversing planer type motor with full automatic control and provision is made by electrical synchronization for keeping both rams working in unison. The motors are carried directly on the saddle and the drive to the rams is by means of the Betts angular shaft drive through a special multiple thread worm meshing with a straight tooth rack. Each ram is counterweighted by means of a unique arrangement employing a guided sliding weight. All important saddle bearings have forced feed lubrication from a power-driven pump. The rams have adjustable cutting and return speeds by means of planer type control panels.

The saddles have feed and power rapid traverse along the crossrail which are driven by a 15-hp. electric feed motor. Provision is made for selecting feed or power rapid traverse, or engaging or disengaging either one from the floor at the operator's position, which adds much to the convenience of operation in view of the height of the machine.

The table has feed and power rapid traverse along the bed, and these movements are driven by the same motor which actuates the saddle movements on the crossrail. An interlocking arrangement is provided so that the saddle and table motion cannot be engaged at the same time.

The machine has a capacity of 10 ft. 2 in. between the housings, 5 ft. under the saddles, and the slotting rams have a 48-in. stroke. The table is 30 ft. long between the pockets and has a width of 9 ft.

A Sliding Head, Self-Oiled Drill and Tapping Machine

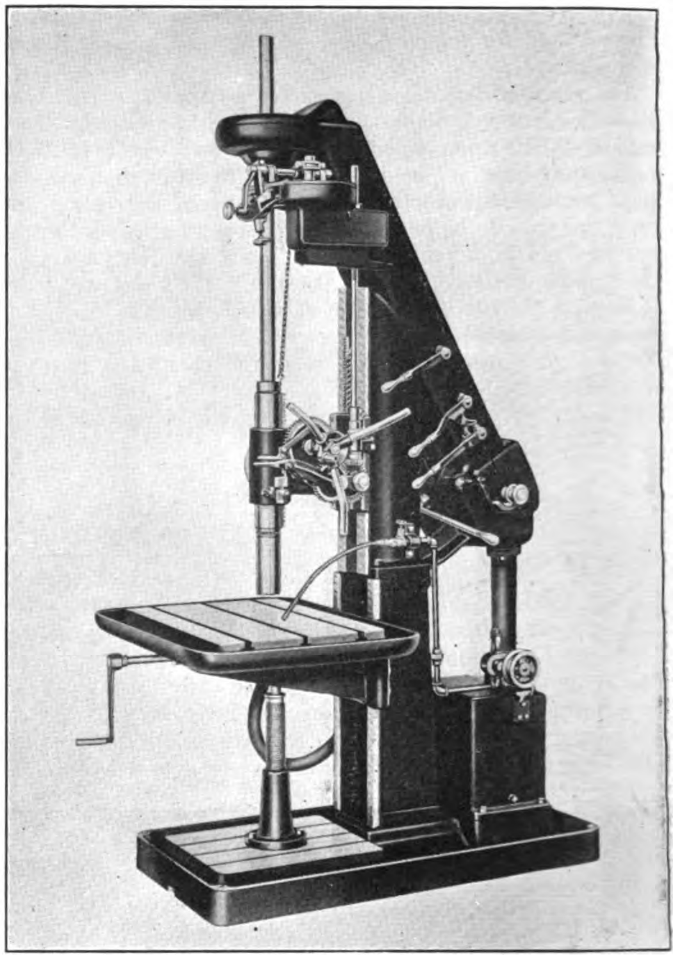
An upright drilling and tapping machine embodying several improvements has been added to the list of drill presses manufactured by the Barnes Drill Company, Rockford, Ill. The machine develops exceptional pulley power, occupies a minimum of floor space, and is conveniently arranged for ease and speed of manipulation.

The machine is provided throughout with ball bearings, which are lubricated by a self-oiling system. The friction is reduced to a minimum on all shafts in the speed change transmission, including the crown gear and drive shaft bearings, by thirteen radial ball bearings. The oil is forced to the various parts of the machine from a reservoir by a pump. This system of oiling provides a continuous flow of oil to the multiple disk clutches and ball bearings.

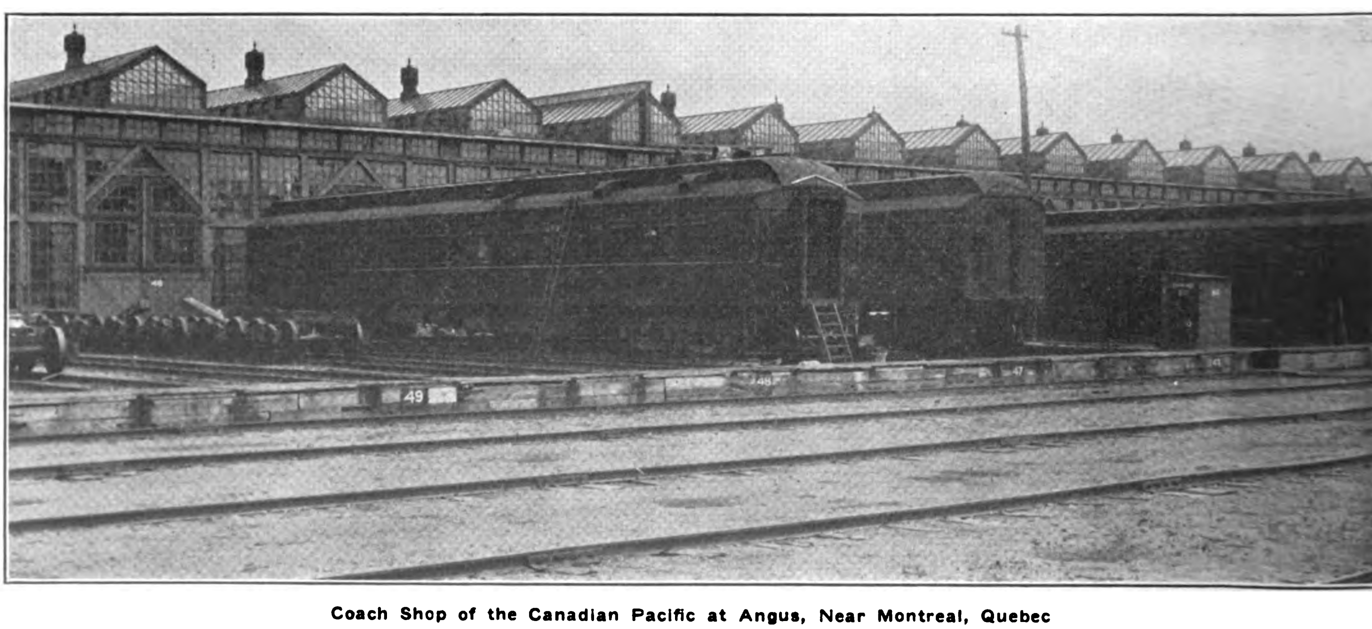
A spur geared feed takes the place of the usual worm and worm gear. The reduction of this gear gives a speed as fine as .005 in. per revolution of the spindle. The rack is dovetailed into the spindle sleeve to take the thrust and is keyed in position. This is considered an improvement over the ordinary method of using screws and dowels. The machine is provided with eight geared speeds and feeds which are directly under control of the operator. Any speed or feed may be used without stopping the machine.

The spindle is exceptionally large and is double splined. The sleeve is 3½ in. in diameter and has a 15½-in. travel. The drift hole is below the sleeve. The head is gibbed to the column face by means of a dovetailed construction which insures perfect alinement. It is raised and lowered easily and quickly by means of a crank pinion operating in a rack and is held at any point within the long travel by two quick-acting clamp screws. An adjustable stop is supplied to clamp in the column face so that the sliding head may be instantly brought back to exactly the same place each time the head is raised. The spindle and head are counterbalanced by a weight which is suspended by a roller bearing sheave wheel.

For tapping, the machine is provided with a friction clutch mechanism the gears of which are on the driving shaft rather than on the spindle. An automatic reversing mechanism is used to reverse the spindle. A reverse speed of 1¾ to 1 is provided at the clutch, which is geared down to 13 to 1 in front of the multiple disk clutch gears. The trip can be set so that the instant the tap reaches the depth required the spindle will automatically reverse, backing out at the increased speed. The shifting lever can be set so that when tripped automatically it will return to neutral position, thus stopping the spindle instantly instead of reversing it.



This Machine Is Provided With a Self-Oiling System and a Dovetailed Rack



Coach Shop of the Canadian Pacific at Angus, Near Montreal, Quebec

GENERAL NEWS

The Carnegie Institute of Technology, Pittsburgh, Pa., has established a special research bureau of metallurgy which will begin its work the first of September, 1924. The express object of the new department is to apply to metallurgical questions the recent discoveries in the field of physics and chemistry. Dr. Francis M. Walters, Jr., has been appointed Director of the new bureau and Dr. Vsevolod N. Krivobok has been appointed assistant. The appointment of another assistant, a specialist in X-Ray work, will be made during the summer months.

Electric Locomotive Development

"The Development of the Electric Locomotive" is the title of a paper presented before the Society of Mechanical Engineers at Cleveland, Ohio, on May 29, 1924, by A. H. Armstrong, General Electric Company. The paper includes specific information on twin geared and gearless electric locomotives and presents the reasons for these types being favored by the General Electric Company for heavy traction service.

City Cannot Force Shops to Stay

The Supreme Court of Missouri has decided against the city of Cape Girardeau in its suit asking for an injunction to compel the St. Louis-San Francisco to maintain and operate its repair shops in that city. The court affirmed the principle, established in previous cases, that municipalities have no power permanently to fix conditions of operation upon a railroad or public utility, in the terms of franchises granted. One justice dissented.

Court Decisions

Fuse Plugs on Boilers—Boiler Inspection Act.—The Texas Court of Civil Appeals holds that, while the Federal Boiler Inspection Act does not require the railroads to furnish boilers absolutely safe under all the conditions common to the service, and there are no regulations requiring boilers to be equipped with fusible plugs, the railroad would not thereby be absolved from liability for accidents resulting from the omission to furnish a fusible plug, "if so simple a device was essential to the safety of a boiler."—Schaff v. Perdue (Tex. Civ. App.), 254 S. W. 151.

Canadian Court Decides American Arch Co. Case

The Superior Court of the Province of Quebec, District of Montreal, in an opinion rendered by Justice Duclos in the case of the American Arch Company vs. the Canuck Supply Company, Ltd., has held that the defendant company has infringed the Canadian patents of the plaintiff company. Justice Duclos issued a permanent injunction enjoining and restraining the Canuck Supply Company, Ltd., the Canadian Fire Brick Company, and their officers, agents and employees from further infringing the patents in question and also ordered an accounting of all the profits made by the defendant by the use of the invention in question since February 10, 1920.

A. R. A. to Investigate Locomotive Service

The board of directors of the American Railway Association announces the appointment of a joint committee of the operating and mechanical divisions to make a study of the utilization of locomotives to determine *A* the percentage of time that should be available to perform actual transportation and *B* the methods for obtaining maximum efficiency while so available.

The joint committee will consist of the following representatives of the operating division, A. E. Ruffer, transportation manager, Erie; T. B. Hamilton, general manager, northwestern region, Pennsylvania; J. T. Gillock, general manager, Chicago, Milwaukee & St. Paul. Representing the mechanical division are F. H. Hardin, chief engineer, motive power and rolling stock, New York Central; O. S. Jackson, superintendent motive power and machinery, Union Pacific; W. H. Fetner, chief mechanical officer, Missouri Pacific.

Wage Statistics for March

Class I railroads reported a total of 1,760,268 employees for the month of March, 1924, a decrease of 56,211, or 3.1 per cent, compared with the number reported for the same month last year, according to the monthly bulletin of wage statistics published by the Interstate Commerce Commission. This decrease occurred chiefly in the number of shop employees. The total compensation in March, 1924, was 5.5 per cent less than in March, 1923. The straight time hourly earnings for the employees reported on an hourly basis increased from 55.9 to 57.8 cents, but the overtime hourly earnings decreased from 80.8 to 80.5 cents. Owing to a decrease in the number of straight time hours worked per employee, and a considerable decrease in the amount of overtime, the employees averaged 214 hours per employee in March, 1924, as against 227 hours in March, 1923, with the net result that their average compensation per month decreased from $136 in March, 1923, to $132 in March, 1924.

Passenger Locomotive Performance on the S. P.

Four sections of the Sunset Limited and six sections of the Golden State Limited, making ten trains in all, left Los Angeles on May 22, 1924, each train being hauled by one of the Southern Pacific's new mountain type locomotives all the way through from Los Angeles to El Paso, distance 815 miles. No trouble was experienced, and all ten of these trains arrived at El Paso on time.

On the same day the Overland Limited, consisting of three sections, left San Francisco carrying passengers on the first day of the summer tourist rate excursions; each section being hauled by one of the new mountain type locomotives, and every section arrived on time at Ogden; and furthermore, arrived on time at Omaha, the terminus of U. P. R. R. Co. and at Chicago, the destination.

The Overland Limited, consisting of twelve cars, is now hauled regularly over the Sierra Nevada mountains, with maximum grades of 116 feet to the mile, with one of the Southern Pacific's new freight locomotives (2-10-2) with no helper locomotive.

Concrete Railway Cars

Iron and wood floors in railway cars in Germany may be replaced by cement if experiments recently conducted there prove successful. A composition known as Eisenbeton, or iron wood, had been used in the construction of the floors of railway freight cars with a great measure of success. The first car was built jointly in 1919 by a railway car manufacturer and a Portland cement concern in Heidelberg. The car, it is reported, withstood concussion at a speed of 27 kilometers and shifting tests were so satisfactory that after five years of service it still remains in perfect condition. The new type of car weighs 20 tons. In appearance it is much the same as an ordinary steel car. The cost of manufacture is said to be much less than for iron, although the concrete car is much heavier. However, in the opinion of the builders, the elimination of the danger of rust tends to offset this disadvantage. The car with the concrete floor requires so little repair, it is reported, in comparison with wood and iron cars that the railway administration is favorably impressed. A company for the manufacture of these cars has been formed at Darmstadt.

New Haven Trying Out New Seating Arrangement in Suburban Cars

The New York, New Haven & Hartford has placed in suburban service out of New York two cars which have been remodelled to increase their seating capacity, by seating three persons on one side of the aisle and two on the other. Each of the cars has a different seating arrangement, one having reversible seats, as in the standard day coach, while in the other car the seats are back-to-back and fixed, similar to the seats in a Pullman sleeping car. The seating capacity of the standard day coach which has

been in use on the New Haven is 75. Under the re-arrangement of seats, the car with reversible seats will accommodate 104, an increase of 29 seats; the car with fixed seats will have 33 additional seats, or 108.

The train on which these cars are in service has been running at the 10-car limit, with a seating capacity of 750 and there have been daily from 50 to 60 passengers standing. It is not practicable to increase the number of cars on the train. However, with the substitution of the two remodelled cars the company expects every passenger will have a seat.

New Freight Car Repair Plant

The Southern Pacific has completed plans for the construction of a freight car repair plant at Houston, Tex., and will begin construction at once. The repair plant and tracks will cover an area of 30 acres which will be filled in to uniform elevation. Two repair yards will be built, one for heavy repairs with a capacity of 130 cars and the other for light repairs with a capacity of 191 cars. These yards will contain a total of approximately 45,000 ft. of track. The shop building for heavy repairs will be 400 ft. long and will accommodate four tracks. A shop and mill building 208 ft. by 40 ft., will also be constructed. Plans also include a shop with 3,200 sq. ft. of floor area which will be used for preparing and assembling wheels and axles. This building will be equipped with boring mills, lathes and wheel presses and will have a depressed track with a concrete platform and mechanical equipment for handling wheels, axles and other heavy parts. Store and supply buildings will also be constructed. The buildings will be of slow burning mill construction covered with asbestos protected metal. The mill will be equipped with automatic sprinkler system and a complete air service system will be installed for the operation of compressed air tools. Construction is to be completed this year.

Detroit & Ironton Electrification

Visible evidence of progress toward electrification of the Detroit & Ironton Railroad may be seen in the Rouge erecting shops, according to the last issue of the Detroit, Toledo & Ironton Railroad News.

Nearly all parts to be used in assembly of the first locomotive are in readiness and the construction will begin probably not later than the middle of July. The locomotive will be 117 ft. long, of the 0-8-8+8-8-0 type. There will be a motor for each of the 16 driving axles. The total weight of the locomotive will be 340 tons and the maximum tractive effort 200,000 lb. The first of the eight turbines which will furnish power for the electrification has passed successful operating tests. It will generate 62,500 hp. A 23,000-volt alternating trolley will be used in conjunction with low voltage motors operating on 600 volts direct current. Metal forms are being made for casting the concrete catenary supports.

Of 6,184 locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during May, 2,931 or 47.4 per cent were found defective and 382 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment. The number ordered out of service was less than had been reported in any month since January 1, 1923, with the exception of December.

New Southern Shops

This company has awarded a contract for the construction of modern shop facilities for the repair of freight and passenger cars at Hayne, S. C., near Spartanburg, to Dwight P. Robinson, Inc. The buildings will all be of masonry and steel construction with modern arrangements for heating, lighting and ventilation, and new machinery will be installed. The following buildings will be erected: Steel freight car repair shop of fireproof construction, 390 ft. by 108 ft., equipped with electrically operated traveling cranes and served by five tracks; annex machine shop, 130 ft. by 50 ft.; coach shop of masonry and steel frame, 240 ft. by 180 ft.; coach paint shop, 200 ft. by 200 ft., with two-story annex for upholstery and other work, 120 ft. by 40 ft.; the coach and paint shop will each be served by ten tracks and by a transfer table of 80 ft. span in a pit 160 ft. long; storehouse and office, 140 ft. by 55 ft.; wash and locker house for employees, 105 ft. by 35 ft.; wheel shop, 105 ft. by 55 ft.; smith shop, 160 ft. by 100 ft.; planing mill, 100 ft. by 100 ft.; power house, 90 ft. by 50 ft.; oil house, 40 ft. by 25 ft.; dry kiln, 40 ft. by 20 ft.; dry lumber shed, 75 ft. by 25 ft.; scrap dock, 400 ft. by 52 ft.; reclaiming shop, 60 ft. by 35 ft.; a service crane with 60 ft. span in a runway 760 ft. long will be located so as to serve the steel car shop, the smith shop and the wheel shop. Approximately 10 miles of track will be constructed in connection with the plant which will be located on a slight grade from north to south so that bad-order cars, brought in from the north end, can be moved practically by gravity entirely through the shop. It is expected that work on the plant will begin as soon as men and materials can be assembled.

Court News

Cars With Defective Power Brakes Must Be in Rear of Power Brake Cars After Passing Repair Station.—In an action by the government against the New York Central for penalties under the federal Safety Appliance Act, the Circuit Court of Appeals, Third Circuit, certified to the Supreme Court of the United States the following question of law: "May an interstate carrier lawfully operate a car equipped with power brakes past an available repair station to destination when its power brakes, becoming out of order in transit, have been cut out of the power brake system of the train and when more than 85 per cent of the cars of the train are equipped with power brakes controlled by the engineer of the locomotive?"

The Supreme Court answered: "No, unless placed in the train in the rear of all cars having their brakes operated by the engineer."

The action concerned two long freight trains moved from Coalburg, Ohio, via Erie, Pa., to Buffalo, N. Y. All the air brakes were in working order when the train left Coalburg, but soon after the air brakes on three cars, the 10th, 40th, and 44th, became defective, and were cut out.

The engineman continued to operate the brakes on the other 60 cars. At Erie repair men and materials were available but the train was run past this repair station and on to Buffalo. The other train had 80 cars, and the facts in respect to it were substantially the same as above.

The railroad contended that, within the meaning of Section 2 of the Act of 1903, the cars having air brakes which were out of order were not "power-braked cars" while in that condition, and that the law did not require their brakes to be operated by the engineer, as at all times power brakes on more than 85 per cent of all the cars in the train were so operated.

The Supreme Court said, in part: "Hand-braked cars have no air line, and it is necessary that they be placed in the train to the rear of the power-braked cars. The cars having power brakes which became defective and were cut out formed a part of the air line. The air line through each of these cars was used to operate brakes on other cars after as well as before the cut-out cocks were turned. Clearly, they were associated together with the other cars equipped with power brakes. . . . Defendant's contention would permit the hauling, in association with cars having their power brakes operated by the engineer, of 15 per cent of the cars in a train with power brakes in bad order and cut out. This would nullify the provision of Section 2 of the Act of 1903. It must be held that the running of the train from Erie to Buffalo in the condition above described was a violation of the law."

The question whether it was a violation of law to haul defective cars to Erie, the place of the first repair station, while associated in the train with the prescribed minimum, was not involved in the case, and no opinion was expressed upon it.—New York Central v. United States. Opinion by Justice Butler. Decided April 28, 1924.

MEETINGS AND CONVENTIONS

The American Short Line Railroad Association will hold its annual meeting at San Francisco, Cal., on August 13, 14 and 15.

Western Railway Club Elects Officers

The annual meeting of the Western Railway Club was held in Chicago on May 19, at which time the following officers were elected: President, F. H. Hammill, general manager, Chicago & North Western; first vice-president, C. G. Juneau, master car builder, Chicago, Milwaukee & St. Paul; second vice-president, W. G. Black, superintendent of motive power, New York, Chi-

cago & St. Louis; secretary-treasurer, Bruce V. Crandall, editor, Chicago & North Western Railway Magazine.

American Railway Tool Foremen's Assn.

The dates for the 1924 convention of the American Railway Tool Foremen's Association have been changed to September 3, 4 and 5, Hotel Sherman, Chicago. The officers of this association are as follows: G. W. Smith, president (C. & O.); Charles E. Helm, first vice-president (C. M. & St. P.); Geo. Tothill, second vice-president (B. R. & P.); E. A. Hildebrandt, third vice-president (C. C. C. & St. L.); J. A. Duca, secretary-treasurer (C. R. I. & P.). The members of the Executive Committee are as follows: C. C. Kuyper, chairman (I. C.); A. Sterner (C. R. I. & P.); T. W. Henson (Wabash); E. F. Miller (C. & E. I.); R. E. Scully (E. J. & E.).

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railroad Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention September 3, 4 and 5, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September 16, 17, 18 and 19.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Locomotive Firebox Company has moved its main offices to 1908 Straus building, Chicago.

The Federal Machinery Sales Company, Chicago, has been appointed representative in the Chicago territory for the U. S. Drill Head Company.

Fred J. Mershon, export sales manager of the Industrial Works, has been placed in charge of the Detroit office with headquarters in the Book building, Detroit, Mich.

J. D. Wallace & Co., manufacturers of portable woodworking machines, is now occupying its new one-story, fireproof factory at 134 South California avenue, Chicago.

Robert Huff, New York representative of the McConway & Torley Co., Pittsburgh, Pa., has removed his office from 2 Rector street to Room 1728, 30 Church street.

The Dale Machinery Company, Chicago, has been appointed the representative in the Chicago territory for the Willard Machine Tool Company, manufacturers of engine lathes.

E. H. Benners and R. W. Benners, railway sales representatives at New York of the American Forge & Machine Co., Canton, Ohio, have removed their office from 2 Rector street to 30 Church street.

P. E. Stouffer, assistant to the general sales manager of S. F. Bowser & Co., with headquarters at Ft. Wayne, Ind., has been promoted to assistant manager of the railroad department, with the same headquarters.

Duncan W. Fraser, vice-president in charge of manufacturing and sales, and Joseph B. Ennis, vice-president in charge of engineering of the American Locomotive Company have been elected directors to fill vacancies.

Philip S. Westcott, formerly assistant car lighting engineer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been appointed special representative for the Pyle-National Company, with headquarters at Chicago.

N. E. Otterson has been transferred from the New York office of the Osgood Company and has been appointed district sales manager, with headquarters at Chicago, succeeding C. A. Phillips who has resigned to go into business for himself.

The B. F. Nelson Manufacturing Company, Minneapolis, Minn., manufacturer of roofing, insulating papers and water proof cotton ducks, has moved its Chicago railroad sales office to the Transportation building, 608 S. Dearborn street, Chicago.

The Chicago Cleveland Car Roofing Company has located its New York offices at 3710 Grand Central Terminal. James L. Stark, general eastern sales representative, will be in charge and associated with him will be Samuel V. Gloss and Goeffrey Winslow.

Arthur L. Pearson, assistant vice-president of the Bradford Corporation, with headquarters at Chicago, has been promoted to general manager with general supervision over manufacturing operations and direct charge of the buying of materials and supplies.

C. D. Price, who for many years has been connected with the Industrial Works, Bay City, Mich., recently as traveling service engineer, has been appointed district sales manager of the St. Louis district with headquarters at the Railway Exchange building, St. Louis, Mo.

K. A. Hills, representative of the General Electric Company at Davenport, Ia., has been promoted to manager, with the same headquarters. S. E. Gates, manager of the Spokane, Wash., office, has been transferred to Los Angeles, Cal., and will be succeeded by Bernard Olsen.

Frank E. McKellip, general foreman car repairer, of the Michigan Central, has resigned to become general foreman of the pipe shop of the Industrial Works, Bay City, Mich. Mr. McKellip will have charge of the installation of all the air brake and piping equipment on Industrial cranes.

The Railway Service & Supply Company and the Transportation Devices Corporation, Indianapolis, Ind., manufacturers of power reverse gears and cut-off control for locomotives have opened a branch office at 332 S. Michigan avenue, Chicago. W. C. Miner, sales manager, has been placed in charge.

George R. Hine is now in charge of the factory management of the New Process Twist Drill Company, Taunton, Mass. Mr. Hine served as general superintendent of the Whitman & Barnes Manufacturing Company, Akron, Ohio, for the past 15 years and was associated with that company for over 23 years.

J. A. Turner, formerly purchasing agent of the Mobile & Ohio, has been appointed representative of the Fairmount Railway Motors, Inc., with headquarters in the Transportation building, Washington, D. C. L. R. Payton has been appointed representative, with headquarters in the Railway Exchange building, St. Louis, Mo.

B. J. Wilson, formerly with the Simmons-Boardman Publishing Company at Chicago, has been appointed western representative of the Pocket List of Railroad Officials published by the Railway Equipment & Publication Co., New York. Mr. Wilson's headquarters are at 605 Fisher building, Chicago. He succeeds Leo Ehlbert.

The Buffalo Forge Company, Buffalo, N. Y., will open on June 2 a new western office at Seattle, Wash. Arthur T. Forsyth of the Buffalo plant will be western representative in charge of the new office. The territory of this office will include the states of Oregon, Idaho, Montana and Washington and the territory of Alaska.

W. J. Roehl has been appointed a sales agent in the railway department of the Newport News Shipbuilding & Dry Dock Company with headquarters in the Railway Exchange building, St. Louis. J. S. Sheafe has been appointed to a similar position with headquarters at 7356 Woodlawn avenue, Grand Crossing, Chicago.

John Wesly Hathaway, assistant vice-president of the Union Draft Gear Company, with headquarters at Chicago, whose death occurred at Naperville, Ill., on March 23 was born in 1870, in Missouri, where he attended the public schools. In his early life he was employed as a carman and a foreman on the Missouri Pacific, the Denver & Rio Grande, the Colorado Southern and other western roads. In the early part of 1910 he was general foreman in the car department of the St. Louis-San Francisco, with headquarters at Kansas City, Mo., and in the latter part of that year he entered the employ of the Union Draft Gear Company in the sales department, which position he held until his death.

J. W. Hathaway

The Gisholt Machine Company, Madison, Wis., has purchased the business of the Milholland Machine Company, Indianapolis, Ind., including the stock of finished machines, parts in process, good will, trade mark, patents, drawings, jigs, tools and fixtures and will continue the manufacture and sale of Milholland machines at Madison.

The Sykes Company, manufacturers of the Sykes rail car has moved its general office at Kenosha, Wis., and its plant at Winthrop Harbor to St. Louis, Mo., where the general offices are located in the Liberty Central Trust building. A contract has been closed with the St. Louis Car Company for all coach and truck work.

S. F. Taylor, of the S. F. Bowser Company, Fort Wayne, Ind., has been appointed eastern representative of its railway sales division. Mr. Taylor has held many responsible positions with the Bowser Company over a period of fifteen years. He will have contact with all railroads having offices in New York City and other eastern points.

The Continental Railway Supply Company, Peoples Gas building, Chicago, has been organized by O. E. Quinton, secretary and treasurer of the Burry Railway Supply Company, Chicago, to sell railway truck and car specialties, including roller bearings, center plates, springs, contact shoes and bus heating equipment. Mr. Quinton is president of the new company.

Robert F. Horsey, for the past six years office manager of the order department of the National Lock Washer Company, Newark, N. J., died suddenly on May 12. Mr. Horsey entered the employ of the National Lock Washer in 1912 and for six years served in the sales department. On September 1, 1918, he was appointed manager of the order department and office manager.

Leigh Best, senior vice-president at New York of the American Locomotive Company, died on April 27 in the Roosevelt Hospital, New York. Mr. Best was born on November 4, 1867, at Chatham, N. Y. After studying law with a Utica firm he entered the legal department of the New York Central where he became assistant to President S. R. Callaway, and when the American Locomotive Company was organized, Mr. Callaway went to that company as its first president and took Mr. Best with him as secretary. Mr. Best subsequently became vice-president of the American Locomotive Company, which position he held at the time of his death. He was also at that time vice-president of the American Locomotive Sales Corporation, the Montreal Locomotive Works, the Richmond Locomotive Works and the Ware Manufacturing Company.

Leigh Best

The Goodwin Side Bearing Company, Inc., with office at 110 East Forty-second street, New York City, has been organized with the following officers: Douglas I. McKay, president, E. G. Goodwin and W. Eckels, vice-presidents, and E. F. Pride, secretary and treasurer. This company will manufacture and sell roller side bearings for railway cars.

B. Franklin Paist, formerly night superintendent of the Baldwin Locomotive Works, died on June 1, at the age of 70. Mr. Paist had been connected with the Baldwin plant for about 48 years. He traveled extensively as a representative of the locomotive works, and during the World War was one of the contingent of American engineers who went to Siberia, serving with the rank of major.

The Pittsburgh Testing Laboratory is now occupying its new laboratories and office building on Stevenson and Locust streets, Pittsburgh, Pa. The building is a five-story, brick-concrete structure, well lighted, ventilated and fully equipped with the most improved types of accurate physical testing machines and chemical apparatus so that all determinations can be accurately performed.

W. C. Peters, New England department manager at Boston, Mass., of the National Railway Appliance Company, New York, has been appointed manager of sales and engineering with headquarters at New York, to succeed W. C. Lincoln resigned. F. M. Richards, salesman in the New York Office, has been appointed New England department manager at Boston, to succeed Mr. Peters.

Janon Fisher, chairman of the board of directors of the Boyden Steel Corporation, Baltimore, Md., recently sailed from New York for London. Mr. Fisher's trip is in connection with an inquiry recently received by the corporation from the high commissioner of the South African Railways for the use of Boyden six-wheel co-ordinating trucks on proposed new and modern equipment. He will also devote considerable time to the corporation's foreign patent situation.

The Continental Railway Supply Company, Chicago, has purchased the manufacturing and distribution rights for the Hartman center plate and side bearings for electric railways from the Burry Railway Supply Company. This company also has been appointed representative of the Mitchell Spring & Manufacturing Company, Johnstown, Pa., manufacturers of coil and elliptic springs for both steam and electric equipment, in the central, central western and southwestern states.

The Mitchell Spring & Manufacturing Company, Johnstown, Pa., has taken over the business of the W. G. Mitchell Spring Works, manufacturers of coil and elliptic springs for steam and electric railway equipment. Fred A. Meckert, general manager of the Ft. Pitt Spring & Manufacturing Company, is president, Joseph Irwin, formerly superintendent of the Ft. Pitt Spring & Manufacturing Company, is superintendent, W. G. Mitchell is vice-president, and L. Harvey Mitchell is treasurer.

John Meeker High, manager of sales, railroad department of the Pantasote Company, Inc., New York, died suddenly of diphtheria in his fifty-fourth year, on April 24, while on a business trip in Chicago. John Meeker High, after a few years' business experience on the Pacific coast, came to New York, and in 1897 became associated with the Pantasote Company, Inc., in the sales department. His advancement was rapid, and in a few years he became manager of sales in the steam and electric railway fields, in which he established a very wide acquaintance and many strong friendships. In 1910 his jurisdiction was extended to cover also the management of sales of a large variety of railroad products known as Agasote and Pantasote. At the time of his death he was also secretary and director of the Agasote Millboard Company of Trenton, N. J., and a director of the Tuco Products Corporation.

J. M. High

Work has been started on a new building seven stories high to include about 180,000 sq. ft. for the Western Electric Company at Allegheny avenue, Clearfield, Ormes and B streets, Philadelphia, Pa. The new building will be used as a telephone distributing house, and it will include office, warehouse and shop space. The building is being erected by a realty corporation, and upon its completion will be turned over to the Western Electric Company on a twenty-year lease. The entire project will cost about $900,000.

The Gibb Instrument Company, Bay City, Mich., announces that its Chicago office is now in charge of W. F. Hebard & Co., 551 W. Van Buren street. Thos. Barnes, an officer of the Hebard Company, will head the welding department. He will be assisted by Chas. Watson, who has had many years of service with the Gibb Instrument Company both in Japan and in the United States. Mr. Hurd, who has represented the Gibb Instrument Company for the past five years, will look after the interests of the company in New England after August 1.

The Marlin-Rockwell Corporation, on April 1, took over the business, trade name and good will of the Gurney Ball Bearing Company. The officers of the Marlin-Rockwell Corporation are: F. W. Gurney, chairman of the board, Henry K. Smith, president, Alfred C. Davis, vice-president and general manager, and John H. Walters, treasurer, with headquarters at 402 Chandler street, Jamestown, N. Y. The management, policy and product of the Gurney Ball Bearing Company will be continued by the new corporation along the same lines as heretofore.

Charles Longenecker, formerly sales engineer with the Bonnot Company at Canton, Ohio, has become associated with the Combustion Engineering Corporation, New York City. Mr. Longenecker was one of the first men to specialize in pulverized fuel and he has been active in this field for many years past. In his new connection he will be identified with the recently created industrial department of the Combustion Engineering Corporation. This department, in charge of H. D. Savage, will specialize in the application of pulverized fuel to industrial work of all kinds.

W. F. Weller, assistant to the vice-president in charge of engineering, of the American Locomotive Company, died suddenly on June 26, in New York City. Mr. Weller entered the service of the Richmond Locomotive Works in 1896 as secretary to the president, Joseph Bryan. Later, upon the formation of the American Locomotive Company, he went to New York as assistant to Mr. Sague, mechanical engineer of the company. He remained in that position until Mr. Sague resigned, since which time he had served as assistant to the vice-president in charge of engineering.

J. H. Slawson, formerly vice-president and general manager of the Joliet Railway Supply Company, Chicago, has been appointed manager of the newly created brake beam department of the Chicago Malleable Casting Company, with headquarters at 435 Railway Exchange building, Chicago. C. A. Benz, formerly assistant general manager of the Joliet Railway Supply Company, has been appointed assistant manager of the brake beam department. The new department has been created for the manufacture of A. R. A. No. 2 and 2-plus brake beams and other railway devices.

J. H. Williams & Co., makers of superior drop forgings and drop-forged tools, having completed the transfer of the manufacturing operations of their Brooklyn, N. Y., and Chicago, Ill., factories to their Buffalo Works, announce that their district sales offices and warehouses will be maintained at 77 Spring street, New York, and 117 No. Jefferson street, Chicago. In New York, E. J. Wilcox will be sales manager of stock, and P. Rigby of special products for the eastern territory, while at Chicago, N. P. Linde will be in charge of stock, and A. C. Nuth in charge of special products for the western territory.

F. J. Lisman & Co., 24 Exchange Place, New York, has announced that it is prepared to assist railways in financing on the installment plan, purchases of new shop machinery and tools or improvements to shops, terminals, etc. In the announcement, F. J. Lisman & Co. says that it was a pioneer 30 years ago in handling equipment trusts before such obligations were as popular as they are today. The company is convinced that great saving in the operation of railroads, can be brought about by the modernizing of shops and division terminals so as to enable the railways to repair to better advantage the heavy equipment of the present day.

Pullman Company Separates Activities

In accordance with plans for the segregation of the sleeping car and manufacturing operations of the Pullman Company, the Pullman Car & Manufacturing Company has been organized with a capital stock of $50,000,000 to take over the entire business and operations conducted by the manufacturing department of the Pullman Company in its plants at Pullman (Chicago), Ill., and Michigan City, Ind. The capital stock, which will be held in the treasury of the Pullman Company, represents the appraised value of the manufacturing properties. Officers of the new company are: President and treasurer, D. A. Crawford, formerly vice-president and assistant to the president of the Pullman Company; vice-president, Clive Runnells, formerly a vice-president of the Pullman Company; vice-president, C. A. Liddle, formerly a vice-president of the Pullman Company; and secretary, S. W. Gehr, formerly attorney for the Pullman Company. Mr. Crawford was born in St. Louis,

D. A. Crawford

Mo., on April 1, 1880, and graduated from the University of Wisconsin in 1905. After serving for two years as an instructor at the university he was appointed secretary to E. F. Carey, vice-president of the American Car & Foundry Company. Five years later he was elected assistant secretary of the company and on January 13, 1916, he was elected treasurer of the Haskell & Barker Car Company. He held the latter position until the consolidation of the Haskell & Barker Car and Pullman companies on January 14, 1922, when he was elected a vice-president of the Pullman Company, which position he held until his recent election.

Clive Runnells

Mr. Runnells was born in Des Moines, Ia., on September 10, 1877, and graduated from Harvard University in 1900. He entered the employ of the Chicago Junction Railway Company in the same year and in 1904 entered the employ of the Pere Marquette as commercial agent, with headquarters at Chicago, which position he held until 1905, when he entered the employ of the Western Steel Car & Foundry Company. In 1907 he was made vice-president of McCord & Co., railway supplies, Chicago, and in 1910 he entered the employ of the American Car & Foundry Company, at Chicago. From 1911 to 1915 he was a partner in Babcock, Rushton & Co., stocks and bonds, and in 1915 he entered the employ of the Pullman Company as assistant to the president. He held this position until May, 1917, when he was promoted to vice-president and assistant to president, which position he has held until his recent advancement.

C. A. Liddle

Mr. Liddell entered business as an employee of the Allison Manufacturing Company, Philadelphia, Pa., and was later associated in turn with the Jackson & Sharp Company, the Harlan & Hollingsworth Company at Wilmington, Del., and the Pressed Steel Car Company, at Allegheny, Pa. In 1901 he entered the employ of the American Car & Foundry Company as an engineer and was later promoted to assistant to the vice-president and then to general manager, which position he resigned on January 1, 1916, to become vice-president of the Haskell & Barker Car Company. On January 14, 1922, he was elected a vice-president of the Pullman Company, which position he has held until the present reorganization.

John W. Fogg, manager of railroad sales, has been promoted to assistant to the vice-president of the Boss Nut Division of the American Bolt Corporation. Mr. Fogg was born in England and moved to Canada when a small boy. He entered railway service with the Grand Trunk and in 1885 came to the United States and served as a locomotive engineer on the Wisconsin Central and later on the Chicago Terminal Transfer which was taken over by the Baltimore & Ohio. Later he became traveling engineer of the Chicago Terminal Transfer and in 1901 was made master mechanic with headquarters at Chicago. In 1915 he left the employ of the Baltimore & Ohio to become sales representative of the Boss Nut Company which position he held until 1919. In the latter year he was promoted to manager of railroad sales.

TRADE PUBLICATIONS

Air Hoists and Trolleys.—Several types of air hoists and trolleys are described in a circular recently issued by the Hanna Engineering Works, Chicago, Ill.

Welders and Cutters.—A 31-page illustrated catalogue has been issued by the Burdett Service, Chicago, descriptive of oxy-acetylene and oxy-hydrogen welding and cutting apparatus.

Machine Shop Tools.—Expanding mandrels, drill and reamer holders and arbor presses comprise the trio of time savers described in Bulletin No. 424 recently issued by W. H. Nicholson & Company, Wilkes-Barre, Pa.

Grinder Chucks.—Circular H, descriptive of pressed steel grinder chucks made in nine sizes to hold 10-in. to 30-in. rings, with hubs to suit all kinds of spindles, has recently been published by the Graham Manufacturing Company, Providence, R. I.

Fans.—The constructional features and applications of fans of the Ventura disk and Sirocco types are outlined in Bulletins Nos. 1613 and 1002, respectively, which have recently been issued by the American Blower Company, Detroit, Mich. Tables of dimensions and capacities are also given.

The Loco-Recorder.—The reasons for the loco-recorder on road engines, and the construction, application and operation of the Models K and S-E loco-recorders are described in detail in a graphically illustrated catalogue recently issued by the Distance-Speed Recorder Company, New York.

Portable Car Hoist.—Bulletin No. N-1452 (0.6389), descriptive of a portable car hoist which combines four operations in one, has been published by the Whiting Corporation, Harvey, Ill. This is a two-page folder, the illustrations showing the manner in which the hoist may be applied to car repair work.

Hytempite.—"Hytempite in the Power Plant" is the title of a 20-page illustrated bulletin issued by the Quigley Furnace Specialties Company, New York. Firebrick masonry; hytempite, why, where and how to use it; boiler furnace economics, etc., are among the details of furnace construction and maintenance described.

Packings.—A short story in pictures entitled "Quality Controlled Packings Have the Same Service Stamina Today and Tomorrow as They Had Yesterday," has been issued by the Garlock Packing Company, Palmyra, N. Y. The booklet contains a number of actual photographs as made in the general factories of the Garlock Packing Company.

Bench Grinder.—The "Hisey" six-inch bench grinder driven either by a d. c. or a. c. one-quarter horsepower motor is described in bulletin No. 1305-A, recently published by The Hisey-Wolf Machine Company, Cincinnati, Ohio. The machine is well provided with standard safety guard, is equipped throughout with ball bearings and is designed only for very light grinding.

Oil as Fuel.—Bulletin "D," a 13-page brochure entitled "Co-operative Advertising of Oil as Fuel," has just been issued by the Mahr Manufacturing Company, Minneapolis, Minn. This bulletin contains a copy of the paper presented by W. M. Horner, president of the Mahr Manufacturing Company, at the first annual meeting of the American Association of Oil Burner Manufacturers held on April 2 at St. Louis, Mo.

Automatic Surface Grinder.—An 11-page illustrated circular has been recently issued by the Blanchard Machine Company, Cambridge, Mass., descriptive of the Blanchard automatic surface grinder No. 16-A. This booklet is devoted principally to illustrations of various classes of work handled on this machine, giving complete production data in each case and a brief description and specifications for the machine itself.

Vanadium Steel.—A 32-page brochure, devoted primarily to illustrations of various types of locomotives equipped with vanadium steel forgings, has recently been issued by the Vanadium Corporation of America, New York. The physical properties of carbon-vanadium steel for locomotive and other forgings, are given in table form. In the captions under each of the illustrations

are listed the forgings for which carbon-vanadium steel was specified.

SMALL TOOLS.—The Brown & Sharpe Manufacturing Company, Providence, R. I., has just issued a new small tool catalogue No. 29, in which over 2,000 precision measuring tools are illustrated and described. Many tools of new and improved design are included, and over 45 styles and 3,000 sizes of milling cutters, gear cutters and hobs are listed. Tables of weights and measures, etc., are also contained in the catalogue, which is 4⅝ in. wide by 6⅝ in. long.

PAINT.—A bulletin has been issued by the Eagle-Picher Lead Company, 208 South La Salle street, Chicago, setting forth the advantages of painting with sublimed blue lead, and furnishing specifications for its use. While the major portion of the bulletin is devoted to a consideration of blue lead, attention is also given to other products manufactured by the company, including paint pigment ground in oil and dry and metal products, numbering in all 24 varieties.

FEED WATER HEATERS.—The second edition of a preliminary catalogue on Elesco feed water heaters has just been issued by the Superheater Company, New York. It describes construction details and fully illustrates the application of the closed, or non-contact heater to locomotives. Of special interest are the four charts in colors at the center of the catalogue, which illustrate the operation of Elesco feed water heaters and the heat balance of locomotives with and without feed water heaters.

HEATING SYSTEMS.—A 235-page, illustrated catalogue, No. 24, has recently been issued by the Gold Car Heating & Lighting Company, Brooklyn, New York. This catalogue, which is of a size convenient for either the pocket or desk, has been prepared for the convenience of all employees coming in contact with the operation and maintenance of car heating systems, making it possible for them, when ordering repair parts as well as complete equipments, to ascertain the correct number or letter and thus avoid unnecessary correspondence and delay.

BRICK PAVEMENT CONSTRUCTION.—The National Brick Paving Manufacturers' Association, Cleveland, Ohio, have issued a 92-page book, bound in cloth, which comprises a treatise on modern brick pavement. The subject is treated in a logical sequence with chapters on drainage, grading, curbs, bases, etc., followed by discussions of the pavement itself. The book is amply illustrated with line drawings of sections of pavement and half-tone reproductions of photographs of a large number of pavements and roads throughout the country. While dealing primarily with pavements, attention is also given to roadways, station platforms, etc.

POSTAL CAR LIGHTING.—The Safety Car Heating & Lighting Company, New Haven, Conn., has issued a 1924 edition of its catalogue on Postal Car Lighting. The catalogue describes conduit, wiring and fixture installations which conform to post-office department specifications and it is distinctive in publications of its kind in that it is, in reality, a text-book on the subject of postal car lighting. It contains 77 pages and is profusely illustrated. It contains post-office department specifications on lighting, descriptions of electric and gas lighting equipment and layouts for 70-ft. and 60-ft. mail cars, and for 30-ft. and 15-ft. mail compartments.

CASTINGS.—"Heat Enduring Castings," a 20-page illustrated brochure dealing with the subject of alloys suitable for the production of castings exposed to temperatures as high as 2,100 deg. F., has been published by The Calorizing Company, Pittsburgh, Pa. This book, based on many years of experience in the production of heat-enduring alloys by the General Electric research laboratory, Victor Hybinette and the engineers of The Calorizing Company, contains an outline of the work of Mr. Hybinette, what heat resisting and heat enduring mean, the field of usefulness of any alloy limited by temperature range, and other interesting data.

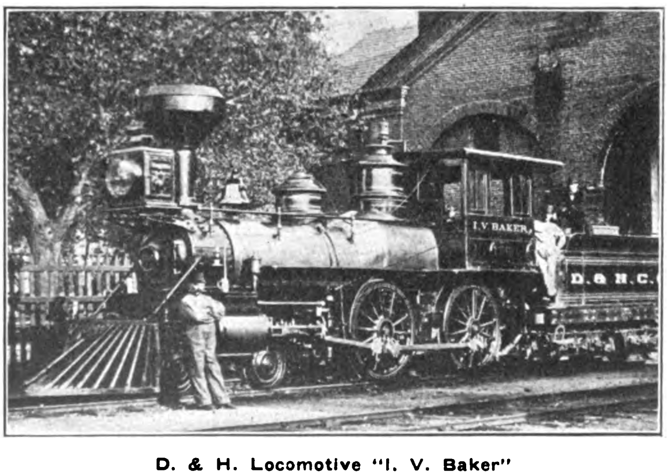
SUPERHEATED STEAM PYROMETERS.—The Superheater Company, New York, has just issued a second edition of its instruction book covering the installation, operation and maintenance of the Model 496 superheated steam pyrometers. While the book is intended primarily to give instructions covering the application of the pyrometer to superheater locomotives, special instructions relating to marine and stationary industrial plants are also given. A pyrometer test set is described, also the inspection, test and maintenance of the pyrometer with and without the test set. An added feature of this edition is the order list covering pyrometer parts in the back of the book.

"HIGHER HOLEAGE."—This is the title of a 60-page educational treatise on the art of making holes, which has recently been issued by the Griswold-Eshleman Company, Cleveland, Ohio. The book is divided into eleven chapters, Chapter 1 dealing with the history of holemaking. The subjects taken up in the succeeding chapters are holemaking by electricity; electric drills—the machine guns of industry; higher holeage—lower costs; unusual uses of Van Dorn drills; holes in a hurry—for shop repairs; the buying of drills for holeage; operation and care of electric drills; electricity vs. air for drilling purposes; tools recommended for various wood drilling operations, etc.

LOCOMOTIVE VALVE GEAR.—An 88-page brochure, descriptive of the Young locomotive valve gear, Type B, has been issued by the Pyle-National Company, Chicago. The booklet is divided into eleven chapters, Chapter I defining many technical terms that are in common use, but which are not always correctly interpreted. Chapter II describes the indicator card, and Chapter III the valve ellipse. Chapter IV gives a general description and details of the Young valve gear, and Chapter V, an explanation of the principles of motion of the gear. Chapter VI is devoted to valve setting; Chapter VII, to breakdown instructions; Chapter VIII, to general information; Chapter IX, to locomotive operation; Chapter X, to locomotive tests, and Chapter XI, to the earning power of a locomotive.

BRISTISH MACHINE TOOLS.—The British Machine Tool Trades' Association, London, England, which was formed in 1910 for the purpose of holding and regulating exhibitions and for dealing with all matters of general interest to manufacturers of machine tools, including woodworking machinery, and engineering supplies, has endeavored to provide foreign buyers with a standard work of reference, covering various products manufactured by its members. This reference, an alphabetically arranged catalogue of 407 pages, gives complete data regarding codes, telegraphic and cable addresses, principal agents, etc., of the advertisers listed therein, and illustrated descriptions of the products advertised. Spanish and French editions of the catalogue, which is 11 in. by 8 in., bound in cloth, are now in the process of preparation.

LOCOMOTIVE BOOSTER.—Instruction book No. 101 has recently been published by the Franklin Railway Supply Company, N. Y. The text contains a general description of the locomotive booster and its elements. The three principle parts of the booster—the engine, the booster control and control system—are gone into in detail by means of text and illustrations. The piping arrangement and control parts of the booster using either saturated or superheated steam are described by means of colored charts which also contain the names of all parts of the device. Complete instructions are included in the text for assembling and checking the crank arm and crank pin and for pressing on the crank arms. Eighteen questions and answers are given in a chapter pertaining to operating instructions. Questions arising in the daily terminal maintenance of the booster are covered by 17 questions and answers in the last chapter.



D. & H. Locomotive "I. V. Baker"

PERSONAL MENTION

General

H. F. WALL, who has been on leave of absence, has resumed his duties as mechanical superintendent of the Atchison, Topeka & Santa Fe, Coast lines, with headquarters at Los Angeles, Cal.

R. G. BENNETT, superintendent of motive power of the Central Pennsylvania division of the Pennsylvania, with headquarters at Williamsport, Pa., has been transferred to the Eastern Ohio division, with headquarters at Pittsburgh, succeeding F. G. Grimshaw.

E. B. DE VILBISS, master mechanic of the Eastern division, with headquarters at Canton, Ohio, has been appointed superintendent of motive power of the Central Pennsylvania division of the Pennsylvania, with headquarters at Williamsport, Pa., succeeding R. G. Bennett.

F. G. GRIMSHAW, superintendent of motive power of the Eastern Ohio division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed general superintendent of motive power of the Southwestern region, with headquarters at St. Louis, Mo., succeeding E. W. Smith, promoted.

Master Mechanics and Road Foreman

J. L. BUTLER has been appointed master mechanic of the Missouri Pacific, with headquarters at Dupo, Ill.

GILBERT BISSON has been appointed master mechanic of the Copper Range, with headquarters at Houghton, Mich.

G W. LLOYD, assistant road foreman of engines of the Chesapeake & Ohio at Russell, Ky., has been transferred to Covington, Ky.

EDWARD CLARK has been appointed master mechanic of the Cornwall, with headquarters at Lebanon, Pa., succeeding John Wintersteen, promoted.

J. B. MERRILL has been appointed master mechanic of the Montgomery division of the Louisville & Nashville, with headquarters at Montgomery, Ala., succeeding T. F. Ryan.

J. A. SHEEDY, assistant master mechanic of the Meadows, N. J., shops of the Pennsylvania, has been appointed master mechanic of the Eastern division, succeeding E. B. DeVilbiss.

STEPHEN I. PALMER, traveling engineer of the Trenton division of the Pennsylvania, has been appointed assistant road foreman of engines of the same division, succeeding B. W. Steelman, deceased.

WILLIAM FITE, fuel supervisor of the Cincinnati and Northern divisions of the Chesapeake & Ohio, has been promoted to assistant road foreman of engines of the same divisions, with headquarters at Russell, Ky.

F. R. BUTTS has been appointed assistant master mechanic of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., succeeding J. J. Simmons, who has been assigned to other duties.

T. F. RYAN, master mechanic of the Montgomery division of the Louisville & Nashville, with headquarters at Montgomery, Ala., has been transferred to the Birmingham division, in the same capacity, with headquarters at Boyles, Ala., succeeding F. J. Monahan, deceased.

W. F. HEINBACH, master mechanic of the Reading at Philadelphia, Pa., has been appointed master mechanic of the Reading and Harrisburg division, with headquarters at Harrisburg, Pa., succeeding G. A. Dugan, resigned. Mr. Heinbach was born on March 21, 1877, at Schuylkill Haven, Schuylkill County, Pa., and entered the employ of the Philadelphia & Reading as a machinist at Reading, Pa., in 1899. In 1901 he was transferred to Harrisburg, Pa., and from 1902 until the time of his recent promotion as noted above, he served successively as enginehouse foreman at Rutherford, East Penn Junction, Bridgeport and Erie avenue, Philadelphia, Pa.

Car Department

T. V. ROBINSON has been promoted to car foreman of the old shops of the Missouri Pacific at Sedalia, Mo.

J. C. FRITTS, master car builder of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has resigned and the duties heretofore performed by Mr. Fritts have been assumed by C. J. Scudder, superintendent of motive power and equipment.

P. KASS, general foreman, car department, of the Chicago, Rock Island & Pacific, at Chicago, has been promoted to superintendent of the car department, with the same headquarters, succeeding E. G. Chenoweth, who has been granted leave of absence.

Shop and Enginehouse

F. D. WRIGHT has been appointed general roundhouse foreman of the Erie, with headquarters at Hammond, Ind., succeeding W. H. Williams, deceased.

W. A. BENDER, general foreman of the Chicago, Milwaukee & St. Paul, with headquarters at Green Bay, Wis., has been appointed superintendent of shops of the Missouri Pacific, at St. Louis, Mo.

C. J. WIARD, division foreman of the Chicago, Rock Island & Pacific at Caldwell, Kans., has been appointed general foreman, with headquarters at El Reno, Okla., succeeding J. W. Finch, resigned.

Purchasing and Stores

GEORGE SHERIDAN has been appointed division storekeeper of the Chicago, Milwaukee & St. Paul, with headquarters at Mobridge, S. D., succeeding D. H. Phebus, promoted.

H. R. TOOHEY, chief clerk to the general storekeeper of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., has been promoted to assistant district storekeeper at Minneapolis, Minn., succeeding G. A. J. Carr.

G. A. J. CARR, assistant district storekeeper of the Chicago, Milwaukee & St. Paul, with headquarters at Minneapolis, Minn., has been promoted to district storekeeper, with headquarters at Deer Lodge, Mont., succeeding J. V. Miller, who has resigned.

F. J. BERECK, general purchasing agent of the Chicago & North Western, with headquarters at Chicago, has also been appointed general purchasing agent of the Chicago, St. Paul, Minneapolis & Omaha, with the same headquarters, a newly created position.

Obituary

F. J. MONAHAN, master mechanic of the Louisville & Nashville at Boyles, Ala., died on Tuesday, May 20.

J. H. CLEMMITT, purchasing agent of the Norfolk & Western, with headquarters at Roanoke, Va., died on May 23. Mr. Clemmitt was born on November 20, 1881, at Richmond, Va., and entered railway service on October 16, 1896, with the Norfolk & Western. His entire railway service was with the Norfolk & Western.

WILLIAM H. LEWIS, formerly superintendent of motive power of the Norfolk & Western, who retired from active service in November, 1918, died in Chicago on June 4. Mr. Lewis was born on October 18, 1845, at Syracuse, N. Y., and entered railway service in 1861 as a machinist apprentice on the New York Central. He was employed on the Chicago, Burlington & Quincy as a machinist in 1864, and in 1869 was promoted to locomotive engineer. Mr. Lewis was appointed general master mechanic on the Northern Pacific in 1873, and he held that position until 1878, when he was appointed division foreman on the Kansas Pacific, now a part of the Union Pacific. He was appointed master mechanic on the Oregon Short Line in 1882, and two years later was appointed master mechanic on the New York, Chicago & St. Louis. In 1888 Mr. Lewis was appointed master mechanic on the Chicago, Burlington & Northern, now a part of the Chicago, Burlington & Quincy, and he held this position until July 1, 1897, when he was appointed superintendent of motive power of the Norfolk & Western. He remained in that position until his retirement in 1918.

Railway Mechanical Engineer

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The Locomotive Steps Ahead

One of the striking facts brought out by Frank Russell in his paper on long locomotive runs, abstracted elsewhere in this issue, is the tremendous increase in the reliability of the steam locomotive. The locomotive of forty or fifty years ago no doubt justified the establishment of all engine districts on approximately a 100-mile basis. But since that time invention, better materials and refinement of design have been effecting a tremendous change in the locomotive, the full significance of which is only now being realized. Now, instead of being a machine of more or less uncertain ability to withstand more than a few hours of continuous service, its mechanical reliability and improved thermal efficiency have increased its capacity for continuous service beyond the possibility of its utilization in all but a few exceptional cases. While improvements in the locomotive itself will continue, the real problem now is the provision of new facilities for handling the locomotive and the realinement of others with which the locomotive coordinates in order that its potential capacity for service may be more fully utilized.

The Apprentice School

Few railroads have gone as far as the Atchison, Topeka & Santa Fe in the provisions they have made for the training of future shop mechanics. In the attention which it devotes to the intellectual training of its apprentices, indeed, it stands alone. Other roads have well developed schemes of shop training and a few give some attention to school room training at a few major shop points, but there is probably no other road in America that can show an apprentice school map which is comparable with that reproduced in an article on another page in this issue. It is not alone for the extent to which school rooms have been established that the Santa Fe apprentice system is notable. The work given these young men is extremely practical and comprehensive. Does this elaborate school system pay? Is it an investment in the future of the students, the return on which will accrue to them and not to the railroad? That the students themselves value the personal opportunity which the school courses offer is evident from the fact that the boys with better than average educational attainments are attracted to the Santa Fe apprenticeship and this in itself is an indirect advantage to the railroad. It is an unpleasant fact that railroad work has ceased to be as attractive relatively as it was a generation or more ago. This means that unless measures are taken to re-establish the old attractiveness, the whole tone of the railroad organization will inevitably have been lowered in another generation. The tone of an industry is determined by the character of the men in it. If the railroads find themselves compelled to fill their ranks from such recruits as are left after more attractive industries have taken their pick, the caliber of officers as well as of the men in the ranks will inevitably be lowered. So far as its mechanical department is concerned, the Santa Fe can face the future with confidence, both with respect to the ranks and the officers. Is not this ample justification for the cost of conducting apprentice schools? Can any railroad afford to do less?

Increasing Locomotive Productivity

The steam locomotive of the present day represents such a vast improvement over, and such a striking contrast to the locomotive of even so recent a time as 15 years ago, that the question arises daily as to what the next step in mechanical development may be. Heretofore unknown traffic demands have stimulated the efforts of locomotive designers and builders and much credit is due them for having developed a machine capable of the remarkable possibilities of some of the present types. But, while striving at all times to develop new types and to increase the efficiency of existing ones, mechanical men should not fail to consider the answer to this question, "Are we getting out of this machine all that it is capable of producing?" Any method by which the service hours and mileage of a locomotive can be increased is a means of increasing its productivity and one way of doing this that is being given consideration at the present time is the extension of locomotive runs. Elsewhere in this issue will be found an abstract of a paper presented at a meeting of the Pacific Railway Club by F. E. Russell, mechanical engineer of the Southern Pacific, in which this subject has been covered in a thorough manner that emphasizes not only the possibilities of increasing service mileage but also the problems that the mechanical man will have to solve in order to insure its ultimate success.

Selecting Men for Gang Foremen

Very careful consideration should be given in selecting a man to fill a position of responsibility. There are always, among a group of workmen, a few who stand out head and shoulder above the rest in the performance of their duties. These men should be considered available timber for promotion. Every characteristic and quality of these men should be carefully considered by the supervisory officers in selecting a man to fill a vacancy. He must be able to maintain the respect of the men who come under him. In order to do this he must thoroughly understand the work he is to supervise. He must be able to convey his knowledge of how to do a job quickly and surely to his men. A supervisor must have a certain amount of executive ability. As a general rule, every man under a foreman must be handled in a different way which requires a knowledge of human nature. The occasion will arise in any supervisor's career when his patience will be tried to the limit, and as a result, he may lose his temper. Such an occasion requires, on the part of a foreman, a display of unusual self-control in the presence of his men. He must be cheerful, loyal and efficient and must be able

to transmit these qualities to his men. The driving, arrogant, egotistical foreman is a figure of the past. The foreman of today must be able to gain the confidence of his men and educate them to the proper performance of their duties. He should be able to analyze the methods of doing things in his shop to see if he is using the best methods obtainable. He should be an exponent of fair and equal treatment, even-handed justice, mutual confidence and faithful performance of duty, with service cheerfully rendered. These points should be carefully considered in selecting men for higher supervisory offices and each time a vacancy is filled the utmost care should be exercised to the end that no injustice is done—either to the candidates for promotion, to the company or to the men to be supervised.

Prevent the Small Losses

When the general subject of fuel conservation is taken under consideration probably the last and least discussed fuel saving possibility is the power plant. It is true that only about 10 per cent of the fuel bill on the railroads is chargeable to power plant operation and in this fact may lie one of the reasons for the comparatively unimportant part the plant plays in the conservation program.

The average railroad power plant furnishing steam and compressed air to shops and engine terminals and possibly a nearby classification yard is a unit in the general scheme of operation that is more or less taken for granted. It rarely attracts much attention until some time when it fails to satisfy the power demand.

When the shop or engine terminal as a whole is laid out the power plant is designed to meet the existing requirements and a reserve factor added to care for possible operating emergencies or increased future demand. Within the plant itself the designing engineer will install modern equipment with fuel-saving devices and recording instruments by which the plant operation may be carefully checked and results compared. The plant operating engineer, by efficient supervision, may be able to produce from each pound of fuel the greatest possible power output in the form of steam or compressed air, but as a rule he has little control over the manner in which it is used.

The utilization of steam and air in shops and around engine terminals is a subject well worth looking into carefully, and, once a systematic investigation of conditions is inaugurated, one factor which will make an impression is the percentage of preventable losses due to waste from insufficient or improper insulation and from leakage, not to mention the injudicious use of steam and air in many places.

Make a tour of inspection of the shops, engine terminal and yards. Notice, for instance, the long outside pipe line or even the inside lines on which portions of the pipe covering has been destroyed and not replaced; leaking steam and air valves, enginehouse blower lines and joints, steam traps which do not function properly and pneumatic tools that have been laid aside after using without having had the air completely shut off. Look into the possibilities of improved methods for thawing out coal cars and locomotive ash pans instead of having the many open steam hose connections that are to be found around the coal pockets and cinder pits. Go out in the yards and note the air leaks around pneumatic switches and in the pipe lines that supply air for pumping up train lines.

There are many of these ordinarily unnoticed sources of loss that have a direct bearing on the coal pile and a serious effort should be made to locate and correct these conditions at this time of the year. The expenditure of a few dollars in repairs and improvements will be returned many times over during the winter months when the demands on the power plant are at the peak and, too often, difficult to meet.

Material Stocks at Engine Terminals

Serious consideration should be given to the installation and maintenance of working stocks of small materials at various points about engine terminals. If the men are properly educated to the advantages incurred by these facilities, considerable time and money can be saved in passing locomotives through the terminal. Stock bins should be located at the inspection pits containing material which can be used to make light repairs on the driving gear, valve motion, air brake equipment and underneath the locomotive. The inspectors would then have to report only the defects which they were unable to repair and the repairmen at the enginehouse or the outbound track would devote all their time to making the heavier repairs. Stock bins located at the outbound tracks should contain metallic packing of various sizes, knuckle pin collar plates, brake shoes, certain complete units of air brake equipment and any other parts which can be applied to a locomotive without sending it to the enginehouse. Engine terminal delays can often be avoided by having these small repair parts conveniently available when an engineman wants some minor repairs made before he leaves the terminal. Stock bins located at these two points will enable repairs to be made to many locomotives without sending them into the enginehouse, thus reducing congestion and enabling the enginehouse foreman to direct the efforts of his men in the enginehouse on those locomotives receiving boilerwash attention or in for more serious defects. Here again the stock sections can be used to advantage. They must be located at proper intervals about the enginehouse taking into consideration the work performed by the various crafts. These bins need not contain large repair parts, as the main storehouse is usually convenient to the enginehouse. They may, however, contain a full supply of nuts and bolts of all kinds and sizes, washers, split keys, cotter pins, and other small parts which are regularly used. The initial expenditure of building the bins or shelves in which the material may be kept will soon be made up by the time and money saved in eliminating the trips to the storehouse for material which these bins contain. A stock section may well be kept for the boilermakers, containing various sizes of staybolts, crownbolts, copper ferrules and caps. The success of these working stocks depends on how well they are kept up and on the degree to which the men are educated to support and use them.

Time Lost at Engine Terminals

The lack of equipment at engine terminals, poor track layout and arrangement of facilities, or in some cases, lack of organization, cause a heavy loss of time. Man hours are lost. Locomotive hours are lost. An intensive study of present engine terminal conditions and operation is now under way by the locomotive utilization committee recently appointed by President Aishton of the American Railway Association, because it is recognized that almost no other factor has a more important bearing on the effective use of locomotives than the conditions at terminals where they are turned and prepared for service.

What are some of the points where man hours, and consequently locomotive hours, are lost? The coaling station and cinder pit are frequent offenders, especially when labor-saving facilities at these points are inadequate. Within the enginehouse, time is lost by the mechanics in covering the circle to locate engines, discover the defects and get the necessary tools and material together to do the work. There is delay in reporting deficiencies either in material, tools or reports. In some cases the supervision is compelled to spend entirely too much time making out reports *after* the work has been done and the engine returned to service. Such post mortem statements are of value as records but should not be allowed to

interfere with the real job of enginehouse foremen and gang leaders, which is supervision.

Improper heating and ventilation make it physically impossible for men to do their best work and while perhaps the normal enginehouse will never be 100 per cent in this respect, the provision of smoke jacks of the proper type, keeping windows clean, blowing off locomotives into a hot-water washout system and keeping the temperature in the enginehouse within a reasonable distance of 60 deg. F. will do much to improve present conditions. In view of the great improvement in recent years in power crane trucks for handling heavy locomotive parts at terminals no enginehouse foreman should be expected to get results without an adequate number of these trucks and the smooth, substantial floor required for their efficient operation. Many of the places where time is lost at engine terminals were pointed out by E. Gelzer, mechanical engineer of the Chicago Great Western, in an article in the February issue of the *Railway Mechanical Engineer.* The intensely practical analysis of enginehouse delays made in this article, together with suggestions for their improvement, make the article well worth re-reading.

Another matter of importance is the method of firing up locomotives at terminals. Many methods have been tried. Enginehouse foremen should keep constantly in touch with what other roads are doing and not be satisfied with their present method simply because it is the one which has been used for years. One railroad has recently demonstrated important savings by kindling fires with a fuel oil torch applied directly to a three or four-inch bed of coal spread evenly over the grates. This method replaced the former method of kindling with scrap wood. It was found that there was no essential difference in the time of the two methods, but the saving in labor cost of cutting up and handling the wood far offset the cost of the fuel oil used with the latter method. Enginehouse men have an important opportunity to affect favorably the cost of railroad operation by studying constantly present terminal operation and putting into effect the plans necessary for their improvement.

New Books

United States Safety Appliances. *A practical manual by H. S. Brautigam, formerly assistant to the master car builder, Chicago, Milwaukee & St. Paul. 232 pages, 3¾ in. by 6 in., illustrated, bound in manila. Published by the Simmons-Boardman Publishing Company, New York. Price* $1.00.

This book is a practical manual of the safety appliance laws, legal decisions rendered in cases arising under them, and Interstate Commerce Commission orders and interpretations covering the application of safety appliances to the motive power and rolling stock of steam railways in the United States. In its preparation, the author has drawn on a wide experience in dealing with the many questions arising in carrying out the provisions of the safety appliance regulations. In order to facilitate reference to the material, it has been divided into ten parts. Part I contains the text of the original Safety Appliance Act, the amendments and supplements thereto and the Ash Pan Act. Part II contains the orders of the Interstate Commerce Commission and the circular of the Master Car Builders' Association relative to the stencilling of cars. Parts III to VI contain the text of the government specifications for the several classes of equipment covered by the enforcing order of the commission, each part devoted to one class. A particularly valuable feature of these sections will be found in the explanatory comments that have been interspersed at numerous points in the text which suggest preferred practices where the text is open to more than a single interpretation. In Parts VII and VIII will be found rules for safety appliances on electric locomotives and on gas, electric and gasoline motor cars, respectively. These classes of equipment are not specifically covered in the order of the commission and, hence, these sections are not official requirements. They are, however, specifications which have been used and found in actual practice to meet the requirements of the law as interpreted by the inspectors of the Bureau of Safety. A very convenient feature of the book is contained in Part IX. This is the official classification of defects to be reported by government inspectors, accompanied by box car and caboose drawings, on which are shown the defect numbers in their proper locations. Reference to the drawings shows at a glance the numbers of all reportable defects and, by referring to the list, the nature of these defects may readily be determined. In Part X have been grouped general rules and definitions applying to all classes of equipment. Some of these rules are included in the various orders of the commission. Others are rulings which have been made in specific cases where doubt or dispute has arisen as to the intent of the law or the interpretation of the commission's orders. Special memoranda of a similar nature applying to specific classes of equipment are also included at the end of the section dealing with the rules for that particular class of equipment.

The illustrations include the official drawings of the Bureau of Safety specifications, and also numerous sketches illustrating alternative types of construction or applications which have been found to meet the requirements in a number of the cases in which questions have most frequently arisen. The book is of convenient pocket size and will prove to be a most useful volume to all who have to deal directly with the inspection or checking of safety appliances on steam railroad equipment.

American Railway Tool Foremen's Association. Year Book, 1923. *232 pages including advertising, 5½ in. by 8½ in., bound in paper. Published by the Association, Chicago.*

This book contains a complete transcript of the proceedings of the eleventh annual convention held by the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, August 29, 30 and 31, 1923. The year book contains a presentation of the proceedings in which will be found several exceptionally interesting articles on the subject of machine tool operation and the reclamation of shop tools and equipment. There are also papers on jigs and fixtures, combination punches and dies and tool grinding, all of which are well illustrated. While the year book will no doubt be of greatest interest to tool-room foremen, there are, nevertheless, many valuable suggestions which shop foremen in general will find it well worth while to give careful consideration.

The Calco Handbook of Recuperation—*Compiled by G. D. Mantle, Engineer, The Calorizing Company, Pittsburgh, Pa., loose-leaf, 160 pages, 8½ in. by 11 in. Published by the Calorizing Company, Pittsburgh, Pa. Price* $3.00.

This hand book, which is designed to aid in the improvement of industrial furnace practice, presents the application of the principles of combustion and recuperation in such a concise and readable manner that the publication can hardly fail to appeal to the railroad mechanical man who is directly concerned with the operation of shop furnace equipment. The text is divided into 13 sections which cover thoroughly the principles of combustion, a discussion of the principles, advantages and possibilities of improvement of combustion by recuperation as well as the theory of design and practical application of equipment utilized in the calorizing process. Thirty full page illustrations, 30 illustrations in the text, 63 full page charts, 11 charts in the text and five pages of tables supplement the text in a way that enables the reader to grasp the important facts immediately.

What Our Readers Think

Courtesy for Good Measure

CLEVELAND, Ohio.

TO THE EDITOR:

I recently heard a lecture to the apprentice class of the Santa Fe railroad at Topeka, Kansas, into which the speaker interjected the following compliment to the railroads:

He said the policy of the Santa Fe could be compared to that of the old-time milkman, who, after having given the customer full measure of good milk, would dip his long-handled ladle again into the big can and bring up just a little more which he would add to the already fair measure. This extra was called a "tilly."

"It is so," the speaker said, "with the Santa Fe and other up-to-date railroads of the present day. They all aim to give full measure of good service, and then a little more, as a 'tilly.'

"And that 'tilly' is courtesy." READER.

One Cause of Rod Failures

COUNCIL BLUFFS, Iowa.

TO THE EDITOR:

When rods fail, as they sometimes do, it is the usual procedure to ascribe it to one of two causes—defective material or abnormal stresses. Certainly these two causes are most plausible and the first to occur to the mind of an investigator. Nevertheless, there are many instances of failure where it would be difficult to prove that one or the other of these factors is the primary contributing cause. Breaks usually occur under conditions of speed and operation such that the damage immediately following the break is very likely to obliterate the evidence.

If rods are of correct design, fabricated from proper material, with the quality of workmanship that such an important piece of machinery deserves, then they should fail only by reason of abnormal stress. Correct design is not easily attained. The stresses under normal working conditions are difficult to determine with accuracy and those of abnormal conditions are hardly to be guessed at. Design must therefore be empirical to a degree and adhere closely to good and conservative past practice. In the matter of materials, steels having highly desirable characteristics are readily available. It is therefore decidedly false economy not to utilize them.

Correct design and the best available material, alone, will not produce the desired results. There is the matter of workmanship. Unquestionably inferior workmanship is the largest contributing cause of breakage. Stresses can only be kept down near normal by having all the work which affects the service of the rod properly and conscientiously done. Quartering of wheels must be exact; tramming likewise. Shoe and wedge adjustments must maintain it. Rods must be exactly trammed when laid out, and finally the actual machining and finishing of the rod must be carefully done. Assuming that wheels are correctly quartered and in tram—for if this work is not properly done no rod will stand up—let us look at the machining of the rods, particularly the finish. Rods should be finished all over, not only planed or milled. Milling is the most desirable method, but the rod should actually be finished by filing and polishing with abrasive cloth to a reasonably good finish, particularly on the part of the rod that is subjected to the greatest bending stress.

It is well known that rods are subjected to both lateral and vertical bending stresses. There is also alternate tension and compression. Machine parts in which combined stresses and reversal of stress occur encounter the severest duty to which machinery can be subjected. Failures naturally occur at the point of greatest stress or at some point where the structure is weakened by a slight flaw, nick or tool mark. A failure must always have a starting point. The sensible thing is to avoid such starting points by eliminating all tool marks and taking care that rods are handled in such a way that they are not nicked or scored.

In research work, machines have been developed to produce what are known as fatigue tests. Their purpose is to concentrate into a few hours or days the actual wear and tear which would be caused by years of ordinary service, the object being to determine how many applications of a known stress are required to bring about failure.

Suppose we have such a machine that will duplicate, on a reduced scale, the stresses occurring in a main rod. Prepare two specimens for test, making them alike from the same material and giving them the same degree of finish. Take one of these test specimens and score it lightly with a scriber, somewhere in the zone of maximum stress, leaving the other as finished. It will almost inevitably be found that the scored specimen will fail much sooner and at the point where scored.

Well finished and polished rods are further desirable in that they can be very easily inspected and incipient failures detected. They may very easily be kept in good condition and appearance by occasional wiping with oily waste. It goes without saying that they should never be painted. Painting will serve only to hide defects that might otherwise be apparent at a casual glance. THOMAS E. STUART.

Old Ideas with New Life

TO THE EDITOR:

A well-known manufacturer of pneumatic tools and machinery recently placed on the market a new type of air valve for general service, which contains several new and valuable features of interest to railways and other users of compressed air. It is a well-known fact that the action of compressed air on valve seats, gaskets and packing of ordinary globe valves is very destructive, and the rapid wear of these parts, resulting in leakage and loss of air in transmission, causes excessive maintenance costs throughout the plant and a great waste of fuel. The high pressures used with modern equipment have increased the losses from these sources, and it was with a view of reducing or eliminating these losses that the new valve was designed.

This valve is of the hollow tapered plug type, in which the air pressure on the large end of the valve plug is utilized to hold the plug on its seat, without the air coming in contact with the seat. The necessity for frequent replacement of plug and seat is thereby eliminated, and, by eliminating also the necessity for packing, stems, gaskets and springs, the number of parts required is reduced to a minimum.

Severe tests of this valve under pressures as high as 500 lb. per sq. in. have demonstrated its ability to withstand successfully the most exacting conditions encountered in modern compressed air service. It is interesting to note, however, that the hollow tapered plug valve, pressure seated, was used in a combination sandblower and brake attachment for locomotives, and patents were granted about twenty years ago.

This is one of many interesting examples of valuable ideas which were partially developed years ago, without their true value being recognized at the time, and were allowed to remain in obscurity when they might have been rendering valuable service. In many similar cases it has remained for the present-day railway shop or railway supply company to develop these ideas to the point where they are adapted to present-day conditions. HOWARD G. HILL.

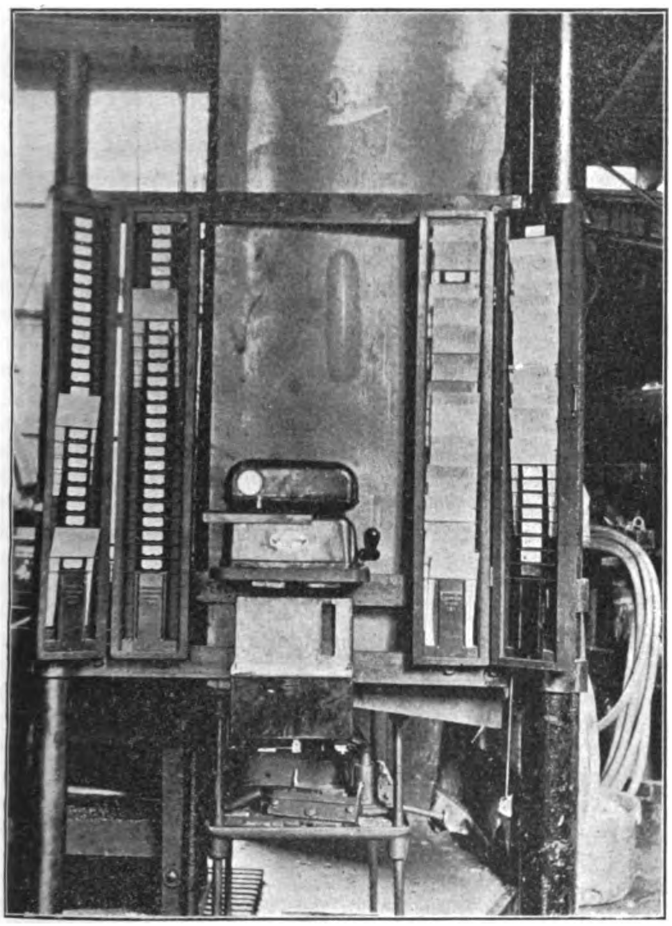
Cost Control for the Mechanical Department

Cost Knowledge and Production Control Bring About an Improvement in Railroad Operating Costs

By George W. Armstrong,
Special Representative, Mechanical Dept., Erie Railroad

CONTROL of industrial operation requires a clear perspective of its countless activities. Effective control requires more, it calls for a digested knowledge of the details and the intricacies of those activities; a knowledge as to the ratio of returns to expenditures to protect the business against the wastes which cannot otherwise be detected.

Railroad accounting is clearly defined by the Interstate Commerce Commission regulations. This uniform classification of accounting serves the purpose for which it was designed. It furnishes, indeed, statistical data of the most valuable kind for the railroad executive in charge of the property, for the investor and for the regulating commissions. But the reports of railroad operation as a whole fail to throw light on the details of its productive activities.



Arrangement of Time Cards and Clock Which Are Used for the Proper Distribution of Labor Charges

Cost accounting is concerned with the details of these primary accounts in railroad operation. One of its prime functions is to enable the executive in immediate charge to know currently the details of what is going on in his plant. Records of cost by themselves cannot effect economy, it is only by their proper presentation in convenient and convincing form to the executive responsible, that he is put in a position to correct the inefficiencies revealed by these records, through improvements in organization, administration and in individual processes and methods. The degree of refinement in a cost accounting system should not exceed that required to secure this result; i.e., effective control. The essentials of any cost keeping system are that it accurately account for materials and supplies purchased and given out; that it charge labor to the work on which it is employed; that it furnish an accurate check and distribution of overhead expense or burden; that it record facts and conditions and provide for current interpretation of their significance.

Responsibility for Cost Accounting

Cost accounting to be of the most value in accomplishing the purposes of production control should be a part of the general scheme of a production organization. It is not accounting, but interpretation of accounts; it is the indicator of individual effort and output. Effective production when and as wanted is secured by a well devised scheduling and routing system. The aid and effective use of cost accounting to control and stimulate production insures that schedules are met and a full return is obtained for money invested.

The full benefit of a cost accounting system depends on a liberal and sympathetic attitude on the part of the accounting department as to its application and operation permitting the basic distribution to be made by the mechanical department as an integral part of its production organization, thus following the plan most effective in the industrial world. The payroll and material disbursements in total become the controlling accounts of which the accounting department look to the cost accounting department for full detailed explanation. Also the records of the cost accounting department are and must be subject to periodical audit and check on the part of the accounting department as far as their interests are involved.

Cost accounting as relates to maintenance of equipment, divides sharply into three branches:

First.—Accounting for the cost of general repairs to equipment units.
Second.—Accounting for cost of finishing parts for equipment repairs prior to shopping of the equipment unit or in quantity for storehouse stock.
Third.—Accounting for maintenance repairs in conjunction with operation; i. e., engine house and cripple track repairs.

General Locomotive Repair Shops

The requirements for cost accounting in a locomotive repair shop are a sub-divided classification of expenditures to the locomotive undergoing repairs, and a shop order system to care for finishing parts in quantity or in advance of the need and of such unusual expenditures as initial superheater application, valve gear, etc.

What is cost accounting to accomplish in connection with general repairs to the locomotive? Is it to secure a record of the exact cost of each shop operation or to furnish an aid to production and a means of determining whether an adequate return is secured for value expended? Obtaining a complete distribution of the time consumed by each workman on each operation will not solve the cost problem, but will result, the more complete and elaborate such distribution is, in getting further from the desired end. The only effect will be a tremendous volume of detailed information practi-

cally impossible of digestion. Grouped charges for individual locomotives backed by complete details entering into these group totals will, however, supply the means for analyzing cost differences, between shops, the individual engines in a class, the differently designed details of various classes of engines and the classes as a whole.

Indicator for Constructive Analysis

For constructive analysis in directing operation in controlling and determining policies based on cost accounting facts and in finding whether a proper equivalent is secured for money expended, labor and material should be charged to master classifications of work by key reference and locomotive number. A standard key, using a memonic reference, i.e., one by its letter combinations suggesting the thing for which it stands, should be established. Such a classification follows:

Cost Accounting Classification for Locomotive Work

AB	Air brake work....	Includes overhauling and applying air pumps, brake valves, governors and all air brake equipment, except piping and foundation brake rigging.
AP	Ash pans	Includes hoppers, door operating mechanism and all work new or old including application.
BA	Brick arch	Includes overhauling and applying brick arch and tubes.
BL	Boiler	Includes all work on shell of boiler, smoke box, exclusive of front end arrangement and smoke box front. Does not include fire box or flues. Does include new front flue sheet.
BR	Brake rigging	Includes overhauling and applying foundation brake rigging for freight engine truck and locomotive, but not tender brake rigging which is included in tender trucks.
CB	Cabs	Includes all work in connection with overhauling cabs and running boards.
CF	Cab fittings	Includes overhauling, etc., all cab fittings, injectors, lubricators, etc.
CG	Cylinder and guides...	Includes all work in connection with cylinders, bolting, bushing, cylinder heads and guides. Does not include steam pipes, valves, pistons, piston rods or crossheads.
DB	Driving boxes	Includes all work in connection with driving boxes, shoes and wedges and cellars.
DG	Draft gear	Includes front end coupler, drawbar, draw castings on locomotives and tender and rear end coupler, also uncoupling mechanism, end sills, pilot beam and pilot.
EH	Electric headlight	Includes repairing electric headlight, turbine, generator and applying headlight and wiring classification lamps and cab lights.
ET	Engine trucks	Includes all work in connection with two and four wheel engine trucks, including center castings and springs but does not include brake rigging.
FB	Fire box	Includes removing and applying staybolts, patching, repairing or applying new parts to fire box, including outside sheets and back flue sheets.
FE	Front end	Includes repairing and applying front end arrangement, smoke box front and door.
FL	Flues	Includes repairing and applying flues.
FR	Frames	Includes all work on main frames, frame braces, pedestal jaws and binders. Does not include trailer and engine truck frames.
GR	Grates	Includes repairing and applying grates and grate rigging.
PA	Painting	Includes all painting, surfacing and lettering of locomotive and tender.
PG	Power reverse gear...	Includes all work in connection with power reverse gear, except piping.
PJ	Pipe and jacket work..	Includes all piping on locomotive and tender jacket repairs and application and lagging boiler and fire box.
PN	Pistons, piston rods and crosshead	Includes pistons, piston rods, packing rings, packing, crossheads and gibs.
RD	Rods	Includes all work in connection with main and side rods, including application.
SP	Steam pipes	Includes throttle, throttle rigging, dry pipe, steam pipes, exhaust pot and nozzle and steam pipe casing.
SR	Spring rigging	Includes spring rigging complete, except engine truck and tender trucks.
ST	Stoker	Includes stoker engine, distributors, conveyors, and other work, except piping.
SU	Superheater	Includes header, damper, cylinder and superheater units.
TF	Tender frame	Includes underframe and flooring. Does not include draft gear
TK	Tank	Includes everything in connection with cistern and coal space excepting stoker conveyor trough.
TT	Trailer trucks	Includes all work on trailer except springs and foundation brake rigging if any.
TET	Tender trucks	Includes all work on tender truck, including spring rigging and brake rigging.
WH	Wheels	Includes all work on driving wheels and axles, including crank pins, counterbalance and wheel hub liners.
VE	Valves	Includes all work in repairing and applying valves, includes bushings for piston valves, steam chests and valve chamber heads.
VG	Valve gear	Includes repairing, applying and setting valve gear.

Provision should be made for checking labor distribution directly in the department and without requiring the foreman or workman to perform any clerical labor in its allocation. The foundation of the value of cost accounting depends upon the accuracy of its elements and this demands proper allocation of charges. Material orders should be issued by one or more men delegated primarily for that duty, thus insuring proper distribution as well as a check on the disbursement of material.

Shop Overhead Accounting

Overhead should be accounted for and distributed as far as possible by departments, a separate shop expense account being kept for each department. Effective control is insured by definitely fixing these indirect expenses along departmental lines, establishing individual responsibility and giving the department executive a means of telling whether his costs are high or low. It also serves to reflect a truer cost on parts manufactured on shop order in quantity or otherwise, with a heavy indirect departmental labor charge and possibly a low direct labor cost.

General expense of the shop such as supervision, building repairs, etc., impossible to allocate by departments, as well as depreciation of shop buildings, machinery and power plant, insurance, taxes and other general accounts (for which provision should be made to take up a proportionate share at the local point) should be pro-rated, first on the basis of the total labor payroll chargeable to Account 308—Maintenance of Equipment, Repairs to Steam Locomotives—as distinct from labor payroll to shop orders. Then to properly reflect the condition in relation to each locomotive undergoing repairs and to serve as a just charge against a locomotive held unduly, the account 308 proportion of this general expense should be allocated on the basis of the erecting shop hours the locomotives have spent in the shop.

The aim of overhead accounting should be to reflect accurately the conditions so apt to be overlooked and which so insidiously sap the earnings by increasing maintenance of equipment expenses. The component parts of overhead as commonly taken up at the local point are all within the control of the local management.

When for any purpose it becomes necessary to ascertain the real competitive costs of effecting repairs or making locomotive and car parts in quantities, it is only a comparatively simple task to reconstruct the accounts for application of an additional percentage to take up the following items carried in general accounts. These items are not necessary for regular consideration in effecting the desired end of production control through cost knowledge. These overhead expenses are:

Pay of shop superintendent or master mechanic, account 301.
Wages of shop clerks to shop superintendent or master mechanic and expenses of shop superintendent or master mechanic, account 301.
Cost of labor and material for repairs to shop machinery, account 302.
Cost of repairing power plant machinery and apparatus, account 304.
Stationery and printing, account 334.
Injuries to persons, account 332.
Repairs to shops and engine houses, account 235.
Repairs to power plant buildings.
Insurance, taxes, interest on valuation, depreciation, proportion of general expenses.

Shop Order System

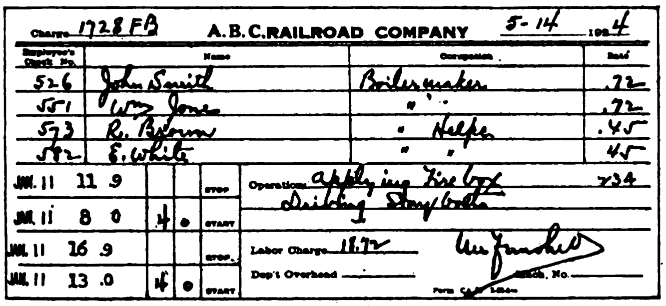
Shop orders should be used for all materials manufactured in quantities, prepared in advance of the shopping of the equipment unit, or finished for outside shops, and to allocate expense for certain improvements chargeable to capital account or for other purposes where it is necessary to segregate the charge definitely. Such shop orders should be keyed to denote the month of issue. This is denoted by the ten-thousand group in which the number occurs, thus 10,067 is a shop order issued in January; 30,152, a March shop order, and so on. Shop orders, as issued should not only designate clearly and definitely what is to be accomplished (no blanket orders allowed) but also the departments upon which it is

issued. The cost accounting bureau should be supplied by the stores department with a copy and no charges should be accepted from any department not listed on the shop order without further authorization.

To permit the following of work and to record progress, a shop order credit slip should be required from the receiving department or storehouse for each transfer and turned in by the originating or sending department to the shop order clerk.

Engine House Operation

Proper determination of running repair costs is virtually impossible under a system of workman time allocation. A workman is not a bookkeeper and the inevitable tendency is to charge the time distribution to the engines in sight at the time of making out such distribution or to take the first



Charge 1728 FB A.B.C. RAILROAD COMPANY 5-14 1924

Employe's Check No.	Name	Occupation	Rate
526	John Smith	Boilermaker	.72
551	Wm Jones	"	.72
573	R. Brown	" Helper	.45
582	E. White	" "	45

JAN. 11 11 9 STOP Operation applying Fire box 734
Drilling Stay bolts
JAN. 11 8 0 4 • START
JAN. 11 16 9 STOP Labor Charge 11.72 Un finished
JAN. 11 13 .0 4 • START Dep't Overhead Mach. No.

Time Card Showing Distribution of Labor Charged to a Fire Box

things coming to mind, whether they represent engines worked on that day or out on the road in service.

A cost system for an engine house, to secure effective control, does not necessitate the degree of refinement demanded for general repairs. Sufficient detail to judge the efficiency of the terminal itself, to afford some basis for comparison between terminals and serve for analysis and equating of facilities, and further to permit of comparative costs as between classes of engines will suffice. Cost statistics of such nature will then permit of analysis as to the comparative maintenance costs of different designs of equipment, between different specialties and appliances and in many ways be productive of benefit in shaping policies for improved operating economies.

The foregoing essentials can be accomplished by, as far as possible, allocating direct labor by classes of locomotives and to a more condensed work classification than that employed in the shop, although using the same symbols. The prefix *R* should be added to denote roundhouse. Such a classification is as follows:

Repairs to Equipment

RAB	Air brake work
RBL	Boiler
RBA	Brick arches
RCG	Cylinders
RCF	Cab work
RFE	Front ends
RFL	Flues
RFR	Frames
RRD	Rods
RSR	Spring rigging
RSU	Superheater
RST	Stoker
RTK	Tender
RVE	Valves
RVG	Valve gears
RWH	Wheels

Handling Engines

AH	Loading or shoveling ashes
BF	Flues cleaned
BP	Packing boxes
BW	Boiler washing
CO	Coaling
DP	Dispatching
FC	Fire cleaning
HS	Hostling
IN	Inspection
PF	Preparing fires
TE	Turning engines
TI	Supplying engines with oil and waste and tool inspection
WE	Wiping engines

Car Repairs

The same general scheme and the same essential need for a cost accounting system applies to the car department. The classification of work charges for passenger and freight car repairs should cover the same detail. However, there is one essential difference as between charges for general repairs to cars and running repairs, in that the former are allocated by individual car units and work classifications, while the latter are allocated in bulk to the work classification only, with one further distinction in the case of freight car repairs, distributed as between home and foreign cars. The following classification is suggestive.

Freight Car Classification	Passenger Car Classification
TK—Trucks	PTK—Trucks
DG—Draft gear	PDG—Draft gear
UF—Underframe	PUF—Underframe
BK—Brakes	PBK—Brakes
HCS—House car superstructure	ST—Superstructure
OTS—Open top car superstructure	SE—Seats
RG—Roofing	PF—Platforms
PA—Painting	PPA—Painting
	PRG—Roofing

While the foregoing method will serve many useful purposes in analyzing where costs of car repairs go, as between different important subdivisions of the car and in certain classes of cars as far as general repairs are concerned, it does not fill all requirements for analyzing freight car costs. Freight cars spend a large portion of their service life on other railroads than the owning one. Analysis of A.R.A. bills will of course give the balance of the story. But here again we are confronted with our old bugbear of impossibility of digesting a mass of details, and the different basis upon which foreign and home costs are necessarily determined. Consequently the suggestion outlined recently by Laurence Richardson deserves careful consideration. This is in brief to designate say 50 in a series of 1,000 cars by a "dummy" private car line, and have all repairs to them, home or foreign, billed in accordance with the A.R.A. billing practice. These cars would be treated on the owning road as foreign cars, as far as charging for repairs are concerned, but with the understanding that in extent of repairs they are to be treated as home cars. Then by employing the group classifications outlined above as well as the car series totals; thorough analysis will show many things with respect to comparative designs of similar car details as well as relative merits of different car designs.

Method of Labor Distribution

A job time card should be utilized for purposes of securing labor distribution. These job cards should preferably be issued by men especially designated for that purpose located at proper and convenient points throughout the shop. These men become in effect assistant foremen, relieving the foremen of all clerical work and giving them more time to supervise and direct the workmen. These cost timekeepers should consequently be practical men and should be viewed as eligible timber for future foremen.

A thorough scheduling system should go hand in hand with a cost accounting system. The cost timekeeper, cooperating with the foreman, should prepare in advance job tickets for each workman to eliminate delays and also to insure meeting the schedule. These job tickets should be racked up by the cost timekeeper so that workmen can obtain new jobs. The time of starting and stopping jobs is marked on the job ticket either by means of an electrically controlled cost recorder or by the foreman or cost timekeeper.

A job time card should be made out for each job worked upon, or for each day's work. By job is meant the unit for which charge is to be found—such, for example, as fitting up a set of side rods for a certain engine, applying a firebox, or making 1,000 set screws on a shop order. Operations like sensitive drilling, threading miscellaneous bolts or other work obviously of small time increment applicable to any specific charge should be treated as departmental overhead.

Where jobs are originated in departments other than those

in which they are to be performed, a job card should be made out by the foreman ordering the work, filled out with the proper charge and instructions as to the operation to be performed and forwarded with the work as authority and instruction for performance.

Operation description on the job time card should be brief, but in sufficient detail to define the work. Where a job is not finished within one day's period, an unfinished job card must be turned in for each day's work.

With the installation of a cost accounting system, if not already in use, should be used a time clock system for checking workmen in and out. The weekly or bi-weekly time clock card, then becomes the instrument for determining payroll earnings, while the job time cards become the distribution of these payroll earnings.

Material Orders

All materials, except nuts, washers, cotter pins, grate pins, split keys and similar materials uniformly used in the car shop, should be ordered on proper material orders. The excepted articles should be carried as a working stock in the department and charged out in the overhead expense of that department. Material orders should be made out by the foreman or cost timekeeper and made by proper engine number and group number, shop order or overhead designation. Each order should be confined to material of one store department class and one charge. Material orders after being priced and extended by the store department will be turned over to the cost accounting bureau for distribution.

Overhead Accounting

Overhead will be divided into two classes as far as shop operation is concerned—departmental and general. These two classifications are as they indicate, those which can be allocated or assigned to a respective department, and those assigned to the shop as a whole.

Shop Expense

General

Shop watchmen
Small tools
Shop tool attendants
Shop switch engine crew
Handling ashes power plant
Stationary firemen and engineer
Unloading coal at the power plant
Shop crane operator
Shop janitor
Cleaning soot
Cleaning shop yard
Whitewashing
Time clock system
Belt repairman
Check clerk
Employment clerk
Distribution clerks
Report clerk
Portion wages passenger in shop superintendent's office
Shop order clerk
Shop messenger
Yard laborers
General foreman
Power } Until basis established
Heating } for departmental
Lighting } distribution
Traveling expenses
Removal snow and ice

Departmental

Lye house, labor and material
Small tools
Cleaning shop
Building fires in blacksmith shop
R. H. tool room attendant
Oiling machinery
Departmental crane operators
Cleaning machinery
Washing windows
Cleaning shop pits
Checking in and out
Departmental laborers
Departmental foremen
Fuel for forges
Working stock material

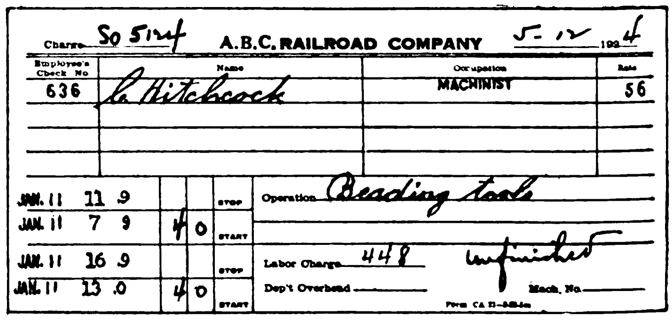
The Interstate Commerce Commission classification of accounts requires that overhead represented by shop expense shall be distributed in the relative proportion which the total amount of charges to shop expenses bears to the total of the directly distributed labor. Owing to the fact that manifestly power, portion of interest, depreciation and repairs to building, etc., applicable to a large slab milling machine or planer are greater than that for an 18-in. engine lathe or drill press; this is obviously not a wholly equitable method of distribution. The effect of this requirement can, however, be to a certain extent offset, inasmuch as it is applicable for primary account distribution and not essentially concerned with the detailed items entering into the primary accounts. Thus the distribution of overhead in a manufacturing department, after its proportion of the whole is determined, can be made on a floor space proportion basis or on any other which would reflect the difference in operating cost of an engine lathe, automatic machine or large turret lathe.

Following in the main, however, the I. C. C. requirement, departmental overheads are to be distributed on the basis of the job labor cost to the total labor charges. General overhead expense is to be distributed on basis of the proportion of erecting shop days during the month to the total erecting shop days.

Cost Distribution

Each day the job time cards for the preceding day will be figured for elapsed time, extended and check to see whether they are complete for each department and agree in total hours with those shown on the in-and-out cards.

After completing extension and check, they will be sorted by job charges and by means of a Dalton listing adding machine, job costs and the balance struck. This is done on a sheet, 8½ in. x 11 in., arranging the figures in columns and leaving a suitable binding margin on the left hand edge. Between each column is left space for recording each group charge, shop order charge, etc., when checking. The daily


Charge SO 5124 A.B.C. RAILROAD COMPANY 5-12 1924

Employee's Check No.	Name	Occupation	Rate
636	C. Hitchcock	MACHINIST	56

JAN. 11	11	.9			STOP	Operation Beading tools
JAN. 11	7	9	4	0	START	
JAN. 11	16	.9			STOP	Labor Charge 448 unfinished
JAN. 11	13	.0	4	0	START	Dep't Overhead ——— Mach. No. ———

Form CA 13

Machinist's Daily Time Card Showing Labor Charge Credited to a Shop Order

sheets obtained thus become a record of the distributed charges and furnish a quick means of ascertaining cumulative charges to any job. Material charges after they are received from the storekeeper will be distributed by jobs and groups in the same manner as labor charges.

Where the volume of work is sufficient to warrant, the punch card system should be employed and electric sorting and tabulating machines utilized to make the necessary distribution and balance. This point in general will be where the volume of work is such that a reduction of $125 per month or more could be effected by the use of such machines.

Cost of Cost Accounting

One of the uppermost thoughts in the executive's mind is "What will cost accounting, or production control, cost?" One answer is, no more than piecework directly, but far less indirectly. A more concrete and comprehensive estimate, however, is given in the following tables:

Locomotive Shop

	No. of workmen	No. of cost men
Blacksmith shop	38	1
Boiler shop	95	2
Carpenter and tank	21	1
Tin pipe and copper, electrician and paint	38	1
Machine, fitting and erecting shop	229	4
Miscellaneous mechanics	25	..
Laborers	64	..
	510	9

In addition, a night force of about 60 to be handled by a foreman, through use of the Stromberg cost recorders.

9 cost booth men at $175 per month		$1,575
3 distribution clerks at $110 per month		330
1 cost accountant		250
		$2,155
Average monthly payroll	$63,000	
Average monthly material charges	54,000	
	$117,000	
Percentage of cost control on monthly charges		1.84

Car Shop

	Foremen	Mechanics	Helpers	Laborers	Total	Cost men
Passenger dept	3	25	5	4	47	1
Paint	2	20	9	..	31	1
Pipe and tin	1	10	..	..	11	1
Upholstery	1	5	1	1	8	1
Planing mill	1	6	1	2	10	
Machine	1	10	5	1	17	1
Blacksmith	1	16	16	1	34	
Freight repairs	5	70	4	2	81	2
Steel car repr	2	54	4	3	63	2

Miscellaneous force:	Foremen	No. of men	Total
Laborers	1	24	25
Storeroom	..	27	27
Scrap yard	2	29	31
Watchmen	..	3	3
Firemen	..	2	2
Engineer	..	1	1

Total cost force:		
9 cost booth men at $175 per month		$1,575
3 material men, checking material after application to car prior to painting at $175 per month		525
3 distribution clerks at $110 per month		330
1 cost accountant at $250 per month		250
		$2,680
Average monthly material charge	$58,500	
Average monthly payroll	77,000	
	$135,500	
Percentage of cost control on monthly charges		1.975

Freight Car Repairs

Assign 1,000 cars to represent 20,000 cars. Assume charges upon A.R.A. bills to average one Hollerith card per day, This requires punching, tabulating and analyzing 1,000 cards per day.

Force

1 analyst at $4,000 per year	$4,000
1 Hollerith punch operator	1,200
Rent of sorting and tabulating machines	1,200
	$6,400

Assume the average cost of repairs per car per day as $160. The amount represented by cost of repairs to freight cars for 20,000 is $3,200,000 and the cost control cost as a percentage of the repair costs, amounts to 0.2.

What Cost Accounting Accomplishes

The results to be obtained from cost accounting will depend on the spirit in which it is undertaken and the cooperation secured from the employees, depending on how effectively it is sold to them. Then too, it will be governed by the actual condition existing in a shop prior to its undertaking. But, unquestionably, in any shop it will afford a more uniform production and point out many otherwise overlooked and undiscovered leaks and possibilities for improvement. A few examples will possibly serve to illustrate.

The cost of cylinder packing rings were observed in one shop to take a sudden jump. Investigation following the cost accounting indications showed the increase largely due to a change in practice, cutting off five rings instead of four at one time. This resulted in getting 15 rings in place of 16 per casting. For a total material cost of $359.10, 135 rings instead of a possible 144 were secured, or a cost of $2.66 per ring instead of $2.49. The actual labor cost per ring was 23.3 cents. The direct labor represented only 8.8 per cent of direct material. Disregarding shop and store expense, labor cost could be increased 73 per cent without entailing any greater increase than the reduction in the number of rings per casting caused in material costs. Two alternatives were presented, either restoring the former practice or modifying the casting to be cut up into 15 rings with a minimum of waste. Had this been undiscovered it could have continued as a constant leak.

Another road discovered after the installation of a cost accounting system, that the painting costs for freight cars seemed high. An analysis of the situation disclosed that owing to the use of small capacity containers for the spray painting, too frequent trips were required to the paint shop for replenishing the supply. With the installation of large capacity tanks, wheeled to the painting zone, a marked reduction in painting expense was effected.

Another road's interesting application of cost accounting, as a production control device, has been the checking of daily output with experience performance tables that had been developed. By means of these experience tables the individual efficiency or department efficiency can be readily ascertained. It has been found that this gives a very effective control over uniformity of output, permits of quickly locating the erratic worker and also cases where production time is unduly increased owing to fixtures, tools, etc., made for efficient production being unused due to need for repair or through ignorance of their existence on the part of a new workman.

Conclusion

An insurance premium of 2 per cent for cost accounting or production control will add about ½ per cent to the burden of maintaining equipment proportion to operating expense. But cost knowledge and production control which can come through such cost accounting and cost analysis should be one of the most important agencies in constructively aiding to bring about an improvement, a substantial reduction in these railroad operating costs. An awakened cost consciousness on the part of the management is the one great hope for bettered operation, for that awakening will lead straight and inevitably to improved facilities, organization and equipment.

Bronze Tablets Are Awarded as Prizes for Efficiency in the Locomotive and Car Departments of the C. M. & St. P.

Extension of Locomotive Runs*

A Discussion of the Advantages of Long Runs and the Mechanical Difficulties Encountered

By Frank E. Russell

Mechanical Engineer, Southern Pacific

WE have read and heard more about long locomotive runs during very recent times than in past years, and as our ideas and thoughts are governed largely by comparisons, what would have been considered a long run two generations ago would be termed a very short run these days.

Shortly after the first steam locomotive was actually put in operation some of the enthusiasts, in discussing and writing about the possibilities of the new machine, became so visionary as to predict that at some day in the future the machine might be so perfected as to travel at the unprecedented speed of a mile a minute. On the other hand, there were many wise men of that day and age who contended it would be impossible for a human being to live traveling at that rate of speed, and furthermore, claimed that it would be impossible to build a machine would could run faster than 12 or 15 miles per hour and hold up under that service.

The development of the steam locomotive has kept pace with the development of civilization, for during a period of about 100 years the steam locomotive has developed from a crude miniature machine, capable of little more than self-propulsion and running not over 15 miles, to a huge, efficient machine capable of handling smoothly and easily luxurious passenger trains consisting of 12 cars weighing 875 tons over mountain, desert and plain at high speed for a distance of 815 miles. The existence of the locomotive corresponds to three generations and its development follows very closely the development of railroading which can also be divided into three characteristic periods, the period of railroad construction, the period of expansion and rule-of-thumb methods and the period of improvement in materials used and application of mathematical talent in computing stresses and proportioning parts.

The locomotives placed in service up to the year 1864 were of crude construction and wrought iron was the principal material used. They were not equipped with power brakes or any of the modern devices.

During the next period, 1864 to 1894, the principal changes in locomotives in this country were generally an increase in size, application of air brakes, automatic couplers, injectors and other appliances and the use of steel in construction.

During the period 1894 up to the present time we find new materials used and much improvement in design, also many new devices developed, not only increasing the power output and durability, but also very materially producing more economy and a higher efficiency. The most important of these devices are superheaters, feed water heaters, brick arches, boosters, improved valve gears, and improvements in air brakes and lubricators, all of which have a marked effect upon the distance over which the locomotive can be successfully operated.

Effect of Topography of the Country

There are many conditions which determine how a locomotive can be economically operated. The first and most important of these is the topography of the country which determines the gradient and curvature, making it necessary to change power to suit the grade conditions.

The location of shop facilities is to a great extent controlled by the character of the country and operating conditions. In most cases these facilities were established many years ago when roads were built to suit the power and equipment then in use, and there is no question but that a great many locomotive runs could be extended more or less if we could easily move the shop facilities to take care of the power. This, however, would mean an expenditure of huge sums of money which could be used to better advantage for other purposes.

Under present day conditions, when terminals and repair facilities have already been located, it requires considerable courage on the part of the motive power and operating officers to extend locomotive runs, especially as they cannot readily increase the runs, say 10, 20 or 30 per cent, but must take a bold step and double or treble the distance. Thus, in referring to long locomotive runs, they are generally considered to be such only when locomotives are regularly operated over two or more districts where the power formerly was changed. The mere fact that locomotives may be successfully operated over an unusually long distance may not necessarily mean the most economical operation. The most important object in extending the length of locomotive runs is to increase their productive time, or in other words, obtain greater monthly mileage from the power.

Terminal Time Non-Productive

The time locomotives are at terminals, in engine houses, etc., is non-productive time. Taking the Class I railroads in the United States during 1921, the average non-productive time of freight locomotives amounted to somewhat more than

*Abstract of a paper presented before the Pacific Railway Club.

TABLE I—SOME OF THE LONG LOCOMOTIVE RUNS MADE ON AMERICAN RAILROADS

Passenger Service

Road	From	To	Miles
Southern Pacific	Los Angeles, Cal	El Paso, Tex	815
M. K. T.	Parsons, Kan	San Antonio, Tex	678
Union Pacific	Kansas City, Kan	Denver, Colo.	640
Southern Pacific	Sparks, Nev.	Ogden, Utah	536
A. T. & S. F.	Winslow, Ariz.	Los Angeles, Cal	602
Union Pacific	Council Bluffs, Ia	Cheyenne, Wyo	509
Union Pacific	Council Bluffs, Ia	Denver, Colo.	562
Union Pacific	Denver, Colo.	Ogden, Utah	577
Canadian National	Montreal, Que.	Toronto, Ont.	334
C. M. & St. P.	Milwaukee, Wis.	Minneapolis, Minn	321
Great Northern	St. Paul, Minn	Minot, N. D.	526
Great Northern	St. Paul, Minn	Winnipeg, Man.	458
Missouri Pacific	Hoisington, Kan.	Pueblo, Colo.	338
St. L. & S. F.	Oklahoma City, Okla.	St. Louis, Mo	542
Kansas City Southern	Pittsburgh, Kan.	Shreveport, La.	430

Freight Service

Road	From	To	Miles
Southern Pacific	Sparks, Nev.	Carlin, Nev.	387
Southern Pacific	Del Rio, Tex	El Paso, Tex	453
A. T. & S. F.	Los Angeles, Cal	Needles, Cal.	310
Union Pacific	Ellis, Kan.	Denver, Colo.	337
Canadian Pacific	Calgary, Alberta	Edmonton, Alta.	180
St. L. S. F.	Memphis, Tenn.	Birmingham, Ala	251
M. K. T.	Parsons, Kan.	Denison, Tex.	278
Union Pacific	Kansas City, Kan	Ellis, Kan.	303
Grand Trunk	Ft. Erie, Ont	Sarnia, Ont.	189
C. M. & St. P.	Chicago	Mahaut, Ia.	209
Great Northern	Havre, Mont.	Wolf Pt., Mont.	202
I. & G. N.	San Antonio, Tex	Palestine, Tex.	260
B. & O.	Cumberland, Md.	Parkersburg, W. Va.	205
B. & O.	Connellsville, Pa.	Willard, Ohio	264
B. & O.	Willard, Ohio	Chicago	278

17 hours out of the 24; hence, the locomotives were idle and not earning two-thirds of the time. In fact, during this time they are not only non-productive, but are actually costing the railroads considerable sums of money for attention and fuel in keeping them hot and otherwise taking care of them at terminals.

The average monthly mileage of freight locomotives in active service on all classes of railroads during the year 1921 was only about 2,400 miles, and for passenger locomotives, only 4,100 miles. Hence, it will be seen that there is ample opportunity for improvement by obtaining greater mileage out of locomotives, which is equivalent to increasing the number of locomotives in service.

Many railroads are cognizant to these advantages, as is revealed by the number of railroads increasing the length of locomotive runs. In Table I several of the more striking examples of long runs in freight and passenger service have been listed and show the remarkable progress that has been made in this phase of operation.

Modern Appliances Facilitate Long Runs

Modern appliances such as the superheater, feedwater heater, brick arch and the booster have contributed to the possibility of running locomotives over greater distances than have heretofore been considered feasible. The effect of the superheater is virtually to increase the boiler capacity. A locomotive equipped with superheater can perform approximately the same work and the boiler only evaporate two-thirds as much water as a saturated steam locomotive. This in turn is equivalent to increasing tank capacity and reduces the amount of scale-forming matter deposited in the boilers over a given run. It also produces increased power at high speed and permits of operating the locomotive at a shorter cut-off. In addition to this, the superheater very largely overcomes carrying water over into the cylinders, which washes off lubricants, and causes lubrication trouble.

The feedwater heater helps to make long continuous runs successful by diverting a portion of the exhaust steam, which would otherwise be wasted, to the boiler in the form of water. This amounts to about 10 per cent, thus making it possible to go somewhat further before taking water and reducing the amount of impurities admitted to the boiler. In addition, as the heat is returned to the boiler there is a saving in fuel, as well as an increase in boiler capacity. In diverting a portion of the exhaust steam to heat feedwater, a reduction is made in back pressure in the cylinders, which in turn increases the power output of the locomotive by probably 2.5 per cent to 5 per cent. A modern locomotive equipped with a superheater and feedwater heater should be able to handle the same train for possibly a 50 per cent greater distance without evaporating any additional water in the boiler. However, such devices, when locomotives are idle, standing at terminals, on sidings, etc., are not making these savings; hence, the importance of keeping them in use.

Brick arches and other improvements in fireboxes and boilers have also done much to increase boiler capacity, fuel economy and reliability.

The booster in many cases will provide the locomotive with sufficient additional power to carry it over some controlling grade on the line, thus fitting it to the service and permitting its operation over a longer run than would otherwise be possible without the use of helpers. The use of boosters in starting heavy trains on grades or slippery rail will usually prevent drivers slipping and spinning, which sets up severe strains in machinery and undoubtedly produces more wear than many miles of actual running.

Effect of Refinement in Design and Materials

Refinement in design and materials of construction has made it possible to build locomotives with ample boiler capacity, sufficient strength of parts and adequate bearing areas, and still keep within the weight limitations. Much has also been accomplished in recent years by improving engine trucks, trailings trucks and spring and equalizing systems, relieving the locomotive of unnecessary shocks and vibrations. Vibration is probably the greatest single cause of failure and regularly exacts its toll of every piece of machinery in operation. One of the most important improvements in recent years that materially reduces shocks and vibrations has been accomplished by utilizing higher grade materials in conjunction with improved design in such parts as connecting rods, crossheads, piston rods, and pistons. The side rods and a portion of the main rod are revolving parts, and the others, such as front end of main rod, crossheads, pistons and piston rods, are reciprocating parts. The reduction in weight of both revolving and reciprocating parts materially reduces the wear on rod brasses and pins. The reduction in weight of reciprocating parts is one of prime importance for we know there is no other single feature that will cause more vibration and set up more destructive strains than counter-balance, either the lack of it or too much of it. The revolving parts we can balance in all directions as both the parts to be balanced and the counterbalance have a rotary motion. With reciprocating parts it is different; they have a horizontal motion and the balance placed in wheel centers to balance them has a rotary motion; hence all weight placed in wheel centers to balance these parts is over balance in a vertical direction and produces a disturbing force on rail. With heavy reciprocating parts in common use 20 years ago, it was necessary to balance two-thirds of the weight of these parts. Reducing the weight of reciprocating parts to less than 1/160 of the weight of locomotive permits balancing only 50 per cent.

Weight of reciprocating parts, to one not familiar with the design and operation of locomotives, might appear somewhat insignificant. It is, however, of prime importance in making the locomotive a more efficient and durable machine.

Advantages of Long Runs

The advantages and economy of running locomotives over two or more divisions when topography of country and operating conditions permit, are as follows:

First—Increased mileage. I have yet to learn of a single case where extending locomotive runs has not resulted in increased mileage over a period of time. However, increasing length of run 100 per cent does not necessarily mean an increase in locomotive mileage of 100 per cent but it does usually range from about 30 per cent to approximately 100 per cent, depending on operating conditions, or, in other words, how the runs fit in with train schedules.

Second—Reduction in number of locomotives required. An increase in locomotive mileage is equivalent to a corresponding increase of locomotives, and as shown by the extension of runs by the Southern Pacific between Sparks and Ogden, the same 15 locomotives made 68 per cent more mileage per month after they were run through, which enabled them to do the same work as 25 locomotives operating over the old runs.

Third—Increased railroad capacity. The railroads of the country today are handling heavier traffic than at any time in their history. They are being hampered on all sides by legislative committees, which makes it very difficult to finance new facilities and equipment; hence the importance of getting the most out of what we have.

Reduction in work for locomotives at small outlaying terminals permits reducing the number of expensive tools required at such points, where they are used only a portion of the time and permits assembling them at main terminals where they can be utilized to greater advantage, thus reducing the investment in these facilities.

Fourth—Economy at Terminals. Locomotives running over two or more divisions do not require at the intermediate

points the attention of wipers, hostlers, ash-pit and coal-dock men, machinists, boiler inspectors, etc. The cost of turning a locomotive after it has made two or more divisions is very little, if any, more than if similar attention had been given at intermediate points, and repairs can be made in a more substantial and workmanlike manner as there is ample time and facilities to take care of them.

Fifth—Saving in fuel. During the year 1921 about one-fifth of all locomotive coal used, or 25,000,000 tons, was consumed when the locomotive was not doing useful work.

Waste of fuel on account of dumping coal fires, and rebuilding fires as well as fuel for keeping locomotives hot is saved, which amounts to a considerable sum. An eastern road reports cost of dispatchment about $12.00 and that at a particular point, on account of running through, the dispatchments were reduced by 28 per day, thus making a saving of $336 per day or approximately $10,000 per month from this cause alone. The amount of fuel required to keep locomotives hot and prevent freezing at outlaying points, in cold climates is a big item. The amount of coal lost in dumping and rebuilding fires is estimated at from one to two tons per locomotive dispatched, and with coal at from $3.50 to $5.00 per ton, this represents an item of importance in the reduction of expenses.

On lines using oil this saving is not experienced, but they do enjoy the saving on account of not having to keep engines hot at intermediate points. At one point alone, in cold climate, this has been estimated at $15,000 per annum.

Possible Disadvantages

Now, let us consider the possible disadvantages, increased cost of maintenance and increase in engine failures. Maintenance is also a factor to be considered in connection with long locomotive runs, since an increase in the daily mileage of motive power and a reduction in the time held at roundhouses would presumably affect the condition of locomotives. For this reason particular inquiry has been made in regard to the average mileage between shoppings of locomotives operated on long runs and it appears where records are available the mileage made by these locomotives between shoppings is as high, if not higher than when run over short runs.

It would appear reasonable that we should get as much if not more mileage out of a locomotive if run off in, say, two years time than in three or four, as we know time and the elements collect their toll whether a locomotive is in operation or not. Also, it is a question if the cooling down and firing up strains in a locomotive do not do more damage than fair service.

In the case cited of the long run on the Southern Pacific between Sparks, Nevada, and Ogden, Utah, since the locomotives went into service they ran off 47,691 miles in ordinary service at the rate of 5,299 miles per month, and up to December 31, 1923, had run off 213,380 miles in long runs, averaging 8,891 miles per month. This makes an average total mileage of 261,000 miles up to January 1, 1924, and will probably average about 300,000 miles before locomotives go into shops for general repairs, which is certainly not discouraging for long runs.

The question of possible increase in locomotive failures has been watched by those interested in long runs and it appears that such failures apparently are not affected by the mileage which the locomotive makes during its individual run. Analysis of failures shows that the majority take place on the first division and that the mileage of the individual runs has little or no effect upon the number of failures experienced.

Locomotives Need Careful Attention

Special attention and care are necessary in making long runs successful. Much depends on the care exercised on the part of engine crew, inspectors and shop forces. A locomotive offered for service must be in good condition, which means that all details requiring attention have received that attention and where repairs are made, that they be of a permanent and not of a temporary nature. This latter practice frequently occurs on ordinary runs, in order to get locomotives back to the main terminal. Then, oftentimes, on arrival at main terminal the men are especially busy, or think they are, and "Let her go for another trip."

Enginemen should report on blanks provided for that purpose all parts that are not working properly or that in their judgment require attention. This is especially necessary where crews are changed, so the proper attention can be given on arrival at terminal.

Lubrication is especially important and the engineman should give particular attention to this; also, shop forces should see that all parts will lubricate properly.

On coal burning roads it is important that the fireman keep his fire in proper condition up to the time he is relieved, so that the fireman taking the locomotive will not be put to undue difficulty.

By building up long runs gradually and supervising closely, these items of lubrication, work reports and fire conditions may be eliminated and no more trouble experienced with them than on shorter runs.

Main Objective

After all is said and done, the consideration of prime importance is, not so much the attainment of the longest possible locomotive runs, as it is to obtain the greatest mileage per unit of time per locomotive owned, with the smallest fuel consumption, and the least expenditure for repairs and enginehouse attention. This can best be done by designing equipment to fit the special service requirements, providing boilers of ample capacity, and applying standard devices that will increase the efficiency and reduce fuel consumption. Particular attention should be given to the design of various details, using high quality material in parts where reduction of weight will minimize the stresses set up in machinery and in track and roadbed. Select the softest natural feedwaters available, and chemically treat those that contain objectionable impurities, reducing these impurities to a minimum, and provide hot water boiler washing facilities at terminals to reduce cooling down strains in the boiler and save fuel.

Discussion

One of the questions which arose during the discussion of Mr. Russell's paper was, "What disposition is made of the reports when one engineman is turning over his engine to another?" One road handles this matter by having the incoming engineman make out his work report, attach his signature and turn one copy over to the outgoing engineman. Another copy is given to the enginehouse foreman or master mechanic at the point where the turnover is made. In this manner one copy of the report stays with the locomotive to the end of the run and a copy is left at the intermediate repair point as a record in connection with government inspection. Another road has issued instructions that the incoming engineman will make his report, place it in a pocket in the cab and the enginemen handling the train over the succeeding operating districts fill in the additional work they may wish to report and, after having attached their signatures to that part of the report made out by them, leave it for the engineman getting off at the final terminal to turn the reports in. It was conceded, however, that the particular manner of handling reports should, in all cases, satisfy the requirements of government inspection.

An interesting point brought out in the discussion was the fact that the majority of the failures which occur on long runs over two or more divisions happen, as a rule, on

the first or second division out of the starting terminal. One road reported that it has been found possible to overcome delays due to minor defects by adding supervision, both on the road and at terminals, and by the analysis of each defect with the idea of correcting the underlying causes immediately. The general conclusion seemed to indicate that ordinary failures occur from improper attention or lack of attention at terminals and that the solution can be brought about by complete co-operation between locomotive crews and enginehouse forces so that necessary work will be promptly and completely reported and repairs made in a permanent manner.

Apprenticeship Methods on the Santa Fe*

It Has Been Found Necessary and Profitable to Provide Highly Specialized School Room Instruction

Part III

THE course of training given Santa Fe apprentices is composed of two co-ordinate branches—that given the apprentices by the shop instructors while they are at work in the shop and that given by the school instructors in the apprentice school rooms, established and equipped for this very purpose. So long as mind is considered above matter, so long will education and development of the mind be considered an essential part of any worthwhile training system.

Apprentices at Work in School Room

Public Schools Do Not Furnish Specific Instruction

The public schools should not be expected to provide the specific instruction or training needed in all varied occupations of life. It will be sufficient if they give the general education needed in all walks of life and lay the foundation upon which may be based the specific education needed for each particular activity. It is becoming more and more evident that the specific instruction needed in any occupation, and particularly in that of an industrial vocation, must be provided by each corporation according to its specific needs.

It is well known that the majority of boys everywhere, particularly those entering industry—and this includes those entering upon apprenticeships in railway shops—have not taken and cannot be made to take full advantage of the opportunities offered in the public schools. United States government statistics show that only 2 per cent of all pupils entering school receive a college education, only 14 percent ever finish high school and only 34 per cent, or one out of three, even complete the work of the common schools.

The unusual opportunities offered apprentices on the Santa Fe have attracted applicants of much more than the average education. The majority have completed the common schools and have had some high school work; many

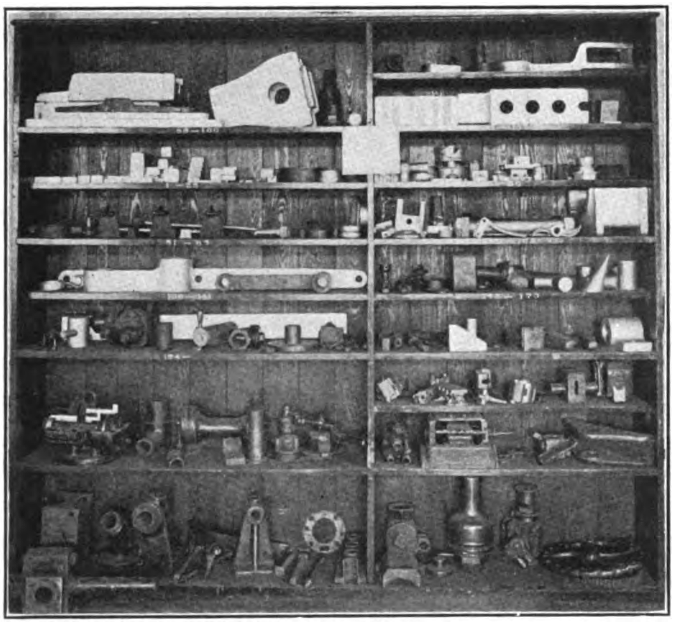
* This is the third of a series of four articles on the apprenticeship system of the Atchison, Topeka & Santa Fe. The concluding article in our next issue will ~~discuss matters of~~ general interest in connection with the apprenticeship system, such as the apprentice boards, instructors' conventions, records maintained, tools furnished, moral training and discipline of apprentices, apprentice clubs, special apprentices, recruiting of instructors, promoted graduates, by-products and direct results derived from the apprentice training system.

are high school graduates. But on most railroads and in most manufacturing plants, the majority of boys entering upon apprenticeships have not attended high school or even completed the work of the common schools. Whether their failure to profit by the education offered in the common schools is due to their own neglect or to unavoidable obstacles, real or imaginary, is immaterial. The fact remains and is indisputable that the majority of boys old enough to enter any industry do not and cannot be made to go to school. The only solution left is to bring the school to them.

Continuation or Part-Time Schools

The public continuation or part-time schools, where similar groups of boys alternate each week, one group working in the shop and the other going to school and vice versa the following week, or where boys are released from the shop (generally on pay) to attend public school one day or a half-day each week, are efforts to meet this situation, but at best they have their limitations. Corporations everywhere are realizing that the only satisfactory solution of the problem is the shop school, established and maintained and conducted by the corporation itself.

These corporation schools are free from outside entanglements and from objectionable and worn out traditions of the public schools, can be managed and conducted by the corporation itself and, best of all, can be made applicable to the specific needs of the corporation giving the training. They have a twofold aim: first, that of correcting the defects or omissions in the previous schooling of these young



Models Used in Teaching Mechanical Drawing

men regardless of their cause; and, second, that of giving them the schooling needed in their particular line of work.

Apprentice Schools on the Santa Fe

With this end in view the apprentice schools on the Santa Fe were inaugurated at the same time the apprentice shop training system was established nearly 17 years ago. They have since been maintained continuously with ever-increasing efficiency. The purpose of these schools is to develop the brain and increase the mentality and reasoning faculties of each of these apprentices and to equip him with that knowledge of his trade and of the subjects relating to the trade which can best be taught by the company itself on company property away from the noise and dirt of the shop, but sufficiently near for convenient accessibility. In brief, the apprentice is taught to use his brain as well as his hands. He is made familiar with the company's standards and methods, its aims and policies, and a feeling of loyalty to the road is kindled and maintained, which is akin to that of the college man for his alma mater.

This school instruction is given on the shop property in rooms provided and equipped for this purpose. The cost of erecting and maintaining these school rooms, of heating, lighting and ventilating them, of supplying the cabinets, the tables, the desks and the lesson sheets, necessary drawing instruments, paper, pencils and all other school room supplies, also that of the salary of apprentice instructors, is borne by the railway company. Moreover the apprentices are paid for the time attending school, the rate of pay being the same as that paid them for time worked in the shops.

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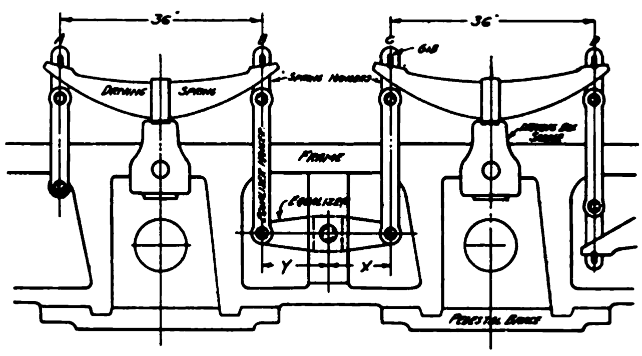
APPRENTICE SCHOOLS — MATHEMATICS, Page 65



Main — Back Intermediate

Spring Rigging

512 What will be the pressure on the top of the main driving box, if a weight of 13,000 lbs. is pulling down on the end of the driving spring at A, and 13,200 lbs. on the other end at B?

513. On a locomotive, Class 900, the weight applied at the equalizer pin is 26,500 lbs. How many pounds are being applied to the hanger at each end of the equalizer if dimension X is 11 in and Y 12 in.? What will be the weight on each hanger if X is 11 in. and Y 11½ in.?

514. Why is it necessary to have dimensions X and Y on equalizer of different lengths?

515. On a certain locomotive having spring rigging arranged as shown in Fig. above, the main driving wheels are found to be carrying too much weight. Which way should the equalizer pin be moved in order to relieve the main wheels of this excess weight? Why?

516. If the weight applied on the equalizer pin on a certain locomotive is 26,500 lbs., where should the center pin hole of the equalizer be located in order to place 200 lbs. more on the hanger C than B? The end holes on equalizer are 22½ in. part.

An Example of the Practical Setting Given to Mathematical Problems

Apprentices Required to Attend School

The apprentices are required to apply themselves diligently and urged to take full advantage of the opportunities offered. They are subject to the same discipline in the school as in the shop. All regular apprentices are required to attend school a total of 208 hours each year, that is, two two-hour periods each week. Absence from school with or without permission is treated in the same manner as similar absence from shop duties. The apprentice is given permission to be absent on special occasions but such permission must be obtained in advance and all absence from school must be made up so that each attends school a total of 208 hours each year. No difficulty whatever is experienced in securing 100 percent attendance. The apprentices appreciate the opportunities offered and strive to make the most of them, their interest increasing as they advance in their apprenticeship. Not infrequently apprentices ask permission to attend school on their own time in addition to the required assignment.

When schools were first established classes were held during working hours, generally from 7 a. m. to 9 a. m. and from 1 p. m. to 3 p. m. Apprentices were assigned to such classes as would least interfere with the work of the shop. For instance, if six apprentices were working on lathes, two would go to school on Monday and Thursday, two on Tuesday and Friday, and two on Wednesday and Saturday. Since the inauguration of the eight-hour day the classes have been held outside of working hours, the majority going to school immediately upon leaving the shop, the others returning to school after supper. In assigning the apprentices to classes before or after supper, consideration is given the apprentices' own wishes and to the distance they live from the shop. So far as possible each is permitted to select the evenings and classes he wishes to attend. Apprentices are treated fairly but firmly. They must be regular in attendance at school and must apply themselves diligently.

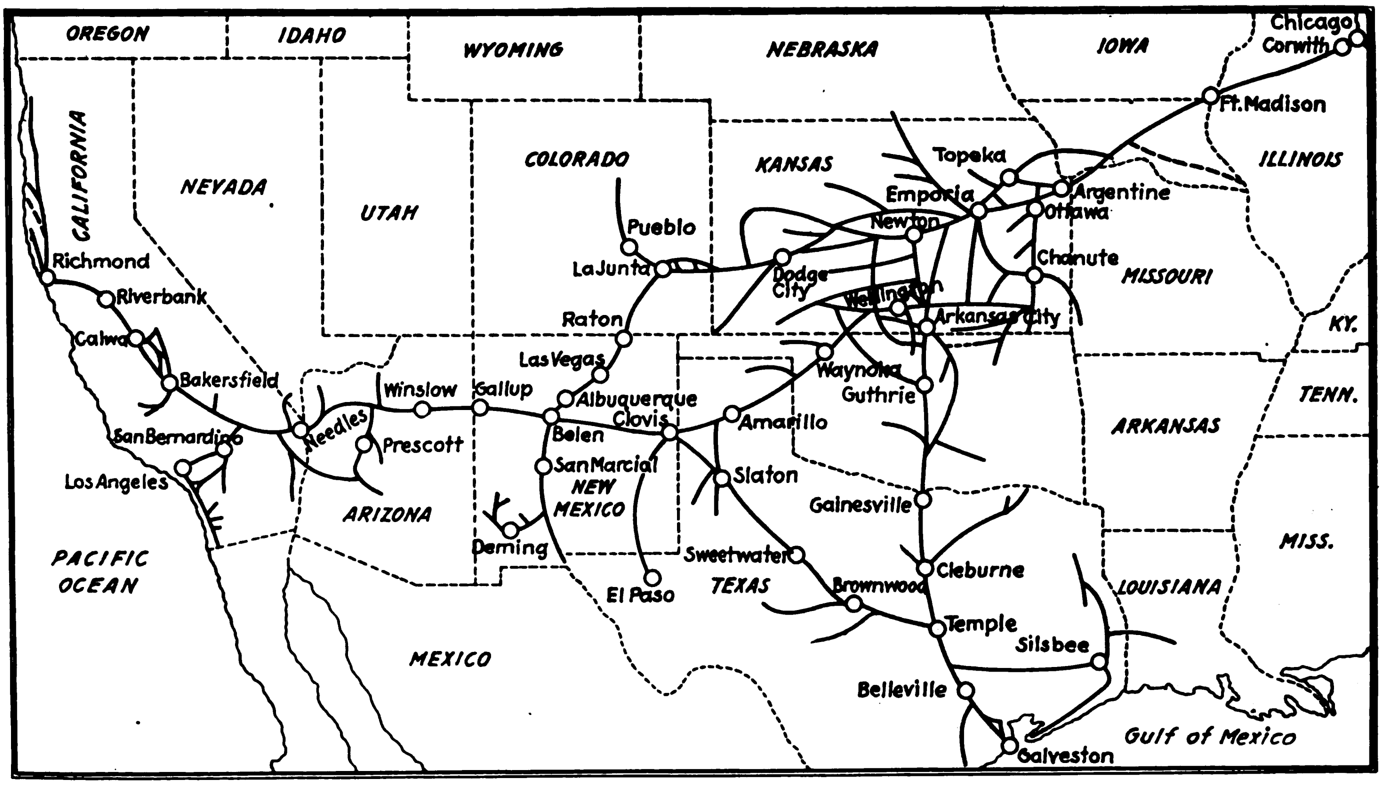
Previous Education of Applicants

The apprentice courses of the Santa Fe have proved so attractive that the average education of beginners is doubtless much higher than that of those entering railway service on most roads. Many have had a high school education or at least a year or two of high school work, but some were compelled to leave school before completing even all the work of the common schools. However, even those who have completed all the work offered in the public schools are not sufficiently prepared for the work of their trade. Much that they did learn has slipped from their memory and cannot be brought to mind or used until they are given a thorough review of these subjects.

The object of the Santa Fe apprenticeship system is not to make mechanical engineers, but to make first-class skilled mechanics, to recruit the shop forces with men trained and educated the "Santa Fe Way." This object is ever borne in mind in mapping out the courses of instruction. The subjects taught and methods used are such as are deemed most beneficial to those of the rank and file, the base of the pyramid referred to years ago by George M. Basford as the foundation of the railroad structure. A few capable of being mechanical engineers forge to the front and are developed under the instruction and training given, but it is for the average boy, or even the backward boy, that the schools have been provided. The methods used are therefore very simple and the subjects taught are those which will be most helpful to a mechanic of the shop.

Subjects Taught and Lesson Sheets Used

The subjects taught are mechanical and freehand drawing, sketching, shop mathematics, the simpler elements of mechanics, business letter writing, the locomotive folio (a book of company standards and practices), Federal rules for maintenance of locomotives and boilers, A. R. A. rules for the carman apprentices and other subjects pertaining to each trade. Lesson sheets instead of text books are used. These are prepared in the office of the supervisor of apprentices, printed on the department's own press, and issued in loose leaf form so that they may be conveniently revised and kept constantly up to date. They are thoroughly practical and made applicable to the particular needs of each apprentice. Separate lesson sheets are used for the different trades.



Map Showing the Location of the 44 Apprentice Schools on the Santa Fe System

These lesson sheets include lists of questions pertaining to each trade. These questions are used not so much to test the knowledge and ability of the apprentices as to assist him in becoming familiar with the various subjects pertaining to his trade. The apprentice is permitted to find out the answers in any way he can, is given such assistance as is necessary but left free to work out many problems himself. After studying the questions he is asked to write out the answers in the school room so that the instructor may know he has personal knowledge of the questions involved. These answers are then corrected, errors pointed out, and the answers re-written. After receiving the instructor's approval they are returned to the apprentice for his future reference.

The apprentice school instructors are men with both a practical and technical education. In general they have

been graduated from some college or technical school and have also served an apprenticeship on the Santa Fe. They are, therefore, familiar with the theoretical and practical operation of each device or part of a locomotive or car or shop tool and with the standards and practices of the road. Like the shop instructors they are men who not only know, but know how to tell what they know—men who by precept and example can lead and guide the young men and inspire them to maximum effort and right conduct.

All Instruction Individual

Much of the success of the apprentice system is attributed to the fact that all instruction is individual. Each boy is treated as a unit. The bright, energetic boy passes along as rapidly as he learns the subject and is not held back because of the slower, duller boy. The slow and plodding boy moves along only as he masters his subject. Each must thoroughly know the subject, branch or class of work, before he will be moved to another. This does not mean, however, that any apprentice is permitted to idle his time or to loaf in the school room, any more than in the shop.

School Room Schedules Show Amount of Work Done

Schedules have been prepared, based on long experience, showing the number of drawings, problems, etc., each apprentice should complete during each period of his apprenticeship in order to complete all the work of the prescribed course. In general the four years' school work of a machinist apprentice consists of:

	Hours
Drawing	646
Mathematics	70
Locomotive folio	20
Valves	15
Air brakes	10
Locomotive rules	10
B. M. rules	5
A. R. A. rules	10
Final examination	30
Miscellaneous	16
Total	832

Certain features of the schedule, such as a study of the boilermaker rules, and A. R. A. rules, may not seem applicable to the machinist apprentices. They are included in this course so that those of special talent may know something about these subjects and be better prepared for a supervisory position at some smaller point. Schedules similar to the one shown above have been prepared for other trades. Each apprentice is kept constantly advised as to whether he is ahead or behind the established schedule, either as to hours of school attendance, drawings, problems, or other work completed.

These schedules have been found of great assistance in increasing the quantity of work done in the schoolroom and in measuring the ability of each apprentice. Since each drawing and problem, or set of answers to questions, must receive the approval of the instructor before the apprentice is permitted to advance to the next lesson, the quality of work done in no way suffers from this incentive to greater effort. An apprentice who is up to the schedule is permitted to do such other work as his instructor deems most beneficial.

Practical Lessons in Shop Mathematics

The lessons in shop mathematics are all clothed in the language of the shop. The examples given relate to some problems with which the apprentice comes in contact in his regular work. They begin with the simpler elements of arithmetic so as to provide the needed review, and advance by easy steps to the more complicated mathematical problems. They include such principles of arithmetic, algebra, geometry or trigonometry, as may be needed to solve the actual problems of a skilled mechanic in the shop.

Advanced apprentice pupils having a previous high school education are first given the regular course and upon completion of this are given work in higher mathematics so as to fit them for special duties. But the regular course is designed for the average apprentice who is being prepared for the work, not of a mechanical engineer but that of a skilled mechanic in the shop.

Method of Teaching Drawing

The purpose of the course in drawing is to prepare the apprentice to read blueprints readily and intelligently and to be able to make sketches whenever desired. The method of teaching drawing differs radically from that ordinarily used in technical or other schools. From the start the apprentice makes actual mechanical drawings from models or the actual parts of a locomotive or car. Geometrical exercises are introduced only as they are needed. The lessons are graded so that the apprentice may advance gradually from the simple to the complex. Each drawing must be approved by the instructor before the apprentice takes up the next. In the first lesson, the apprentice is required to reproduce three views of the drawing of a simple object. In the next lesson one view is missing and must be supplied by the apprentice. Then comes a drawing showing a hidden line, later one which involves the use of the triangle; still later, exercises are given involving circles and arcs and the use of the protractor. The apprentice advances by easy steps and is given only one new principle at a time with sufficient repetition to fix the various principles firmly in mind. Sufficient instructions are given on each lesson sheet so that apprentices require little assistance from the instructor. This makes it possible for one instructor to supervise the work of as many as 20 or 25 apprentices, even though all are working on different lessons.

SANTA FE SYSTEM
APPRENTICE SCHOOLS

Questions of Shop Work

Machinist Apprentices

FEDERAL INSPECTION

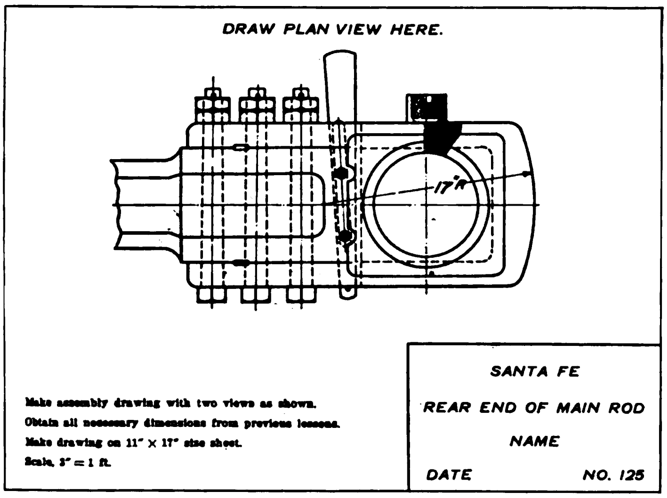
1. What are Federal Rules? Are you familiar with them?
2. Where and how should steam gauge be located? How often should it be tested?
3. Explain fully how safety valves should be set.
4. How many gauge cocks must a locomotive have? Where located? Do Federal Rules differ from Santa Fe Rules regarding gauge cocks? In what respect?
5. How should brake and signal equipment be maintained and when tested?
6. What is the maximum allowable lateral on engine truck wheels? Trailer wheels? Driving wheels?
7. How should crossheads be maintained and what is the maximum amount of lateral allowable?
8. How often should draw bar and draw bar pins between engine and tender be inspected? How much lost motion is allowable between engine and tank?
9. Give five Government defects of driving wheels and tires that will cause an engine to be removed from service.
10. Give ten other Government defects that will cause an engine to be removed from service.

(Apprentice should first write the answers on arithmetic pad. After correcting, he must print on regular drawing sheet).

General Questions Which the Machinist Apprentice Must Answer

Separate Drawing Lessons for Each Trade

The first one hundred lessons are common to apprentices of all trades and serve to establish general principles and to give the apprentice facility in lettering and in the use of the various instruments. The remaining hundred lessons of the drawing course are made applicable to each particular trade, there being a different set of lessons for each trade. All lessons apply to the work with which the apprentice must be made familiar. Boilermaker apprentices are given work in laying out; also, in calculating the strength of patches. Carman apprentices are given lessons relating to the repair of freight cars, safety appliances and A. R. A. rules of interchange. So with all trades. The objects used in all drawing lessons are those which the apprentice finds in his daily work. He must not only know how to make an accurate drawing of each object or model used in the course, but must know where the object is used and its purpose. Most of the work in drawing is done with pencil rather than with ink, the object being not to make draftsmen, but skilled mechanics who can read blueprints readily and make accurate, intelligent sketches.



A Drawing Problem

Developing Draftsmen

The boy with talent in drawing is given special opportunity, including work with ink and on tracing cloth, to develop him into a first-class draftsman. In fact, nearly every graduate of the course is thoroughly qualified for any drafting work that may arise, either in the shop or in the drawing room. Many of the draftsmen in the office of the mechanical engineer are graduate apprentices who have not only ability as draftsmen but also the practical knowledge of a trade. The shop drawing and sketching at each of the various shops and roundhouses is done by an apprentice detailed for such work under the supervision of the school instructor. Apprentices are assigned to such tasks in rotation, so that each may have about one month's experience on such work.

Synopsis of School Work

The illustrations are suggestive of the nature of the drawing lessons, and speak for themselves. Illustrations of representative lessons in mathematics and of the questions which apprentices must answer, are also given. All of this work is done in the schoolroom, under the guidance and supervision of the instructor. The schedule of school work for each trade stipulates the approximate time to be devoted to each class of work, this being varied, of course, according to the ability and progress of each apprentice.

Each schoolroom is freely supplied not only with railway publications but also with literature issued by the various railway supply companies relative to devices in use in that particular territory. In fact, when new devices or appliances come out, the instructors and apprentices are often the first to become familiar with their installation, operation, and maintenance. Each school also has its reference library and reading table. No apprentice, however, is permitted to do any special work in the schoolroom unless he has completed the standard requirements prescribed for an apprentice of his age in service.

The work outlined in the lesson sheets is supplemented by oral instructions given by the instructor to the apprentices, individually or collectively. Frequently talks or lectures are given by the instructor on educational or practical subjects. Sometimes talks are given by railway officers or by railway supplymen or other experts along special lines. Occasionally use is made of the moving picture to show the construction and operation and method of making repairs to a particular device.

Use is also made of working models, particularly in teaching valve motion. The school instructor works in harmony with the shop instructor, so that when an apprentice is working on certain classes of shop work he may at that time or just previously be given work in the school which will assist him in mastering his work in the shop. Nothing is left undone to make the instruction given in the schoolroom as efficient and practical and beneficial as it is possible to make it. Perhaps no single feature of this training system is more beneficial than is the opportunity given each apprentice to ask questions about matters in which he is interested or in doubt. Not only is he given the opportunity of asking questions but he is urged to do so, being assured that no matter how simple or uncalled for his question may appear, it will be answered freely and without ridicule. If the instructor is not prepared to answer questions offhand, he is in position to refer the question to someone who can give a satisfactory answer.

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Apprentice Schools. 150 X

QUESTIONS ON SHOP WORK
CARMAN APPRENTICES

LUBRICATION

1. How should packing for lubricating car journals be prepared?
2. What should be done with packing when it is necessary to jack up box to remove brass?
3. Give an outline of how a journal box should be packed to insure proper lubrication.
4. Should water-soaked packing be reapplied?
5. Give proper method of inspecting a journal box to see that it is properly packed.
6. What equipment is used in packing journal boxes?
7. What do you understand by the term "hot-box?" Name several of the principal causes of same.
8. What is meant by "periodical repacking" of journal boxes?
9. When changing wheels on cars what special precautions must be taken in regard to packing, brasses, wedges, dust guards, etc?
10. Give the names of six parts of an assembled journal box and the function of each.

A Typical Sheet of Shop Work Questions for the Carman Apprentice

Two features of the school instruction differ materially from that given in the public schools—first, the individual rather than class instruction; and second, the use of the object itself or a model thereof rather than a blueprint or sketch. Nothing is taught the apprentice in the abstract which can be given a concrete illustration, or made directly applicable to the trade the apprentice is learning.

Results from School Instruction Justifies Cost

It is more difficult to measure the results received from the school instruction than those received from the shop in-

struction, but they are such that it, too, more than justifies its cost.

The apprentices are taught to think, to use their heads as well as their hands. Their ability to read blueprints readily makes them more accurate and efficient in their shop work. More and better work is done by the apprentices in the shop because of the training received in these shop schools. Incidentally, a much better class of boys are attracted because of the opportunities offered in the apprentice schools. They, in turn, do more work and better work and make better mechanics than boys of lesser ability who would otherwise be employed. From these boys of greater fitness are developed not only mechanics for the rank and file, but men for staff duties, for foremanship and other positions of leadership.

Report of Committee on Feedwater Heaters*

The number of feedwater heaters applied or on order up to May 1, 1924, is 2,123. During the current year heaters have been applied on 21 switching locomotives and the roads report savings in this service.

The report gave a brief summary of the difficulties being encountered in the maintenance of both open and closed type heaters and the means which have been, or are being developed to overcome them. Some of these are being overcome by a redesign of the parts and others by modifications in heater operating practice.

Exhaust Steam Injectors

The exhaust steam injector has been tried out on nine different roads in this country and on a total of 24 locomotives. The first design, of which 19 were applied, involved the use of levers for controlling the injector. The last five injectors applied are equipped with a single control valve somewhat like an engineer's brake valve which distributes steam to pistons for operating the various valves and greatly simplifies the handling of the feedwater injector by the engine crew.

Objections to the exhaust injector as compared with the feedwater heater pumps are its limited range, which is about the same as that of the live steam injectors, and its falling off in economy as the temperature of the water in the tender increases. One road which had a Mallet locomotive equipped with an exhaust steam injector in mountain territory, exchanged the original for one of smaller size in order to be able to use it continually instead of cutting it in and out of service.

The road, which has the greatest number of exhaust steam injectors in service, reports after a two-years' service test practically no trouble to get the men to operate the injectors as they become more familiar with them; that the superheat temperature obtained with the injector working exhaust steam is about 15 deg. less than when working the live steam injector; that the exhaust steam injector when using exhaust steam requires more attention than the live steam injector, but is as reliable as the live steam injector when in good condition, and that it will not blow back in the tank or work improperly without giving indication at the overflow. This road reports that the exhaust steam injector undoubtedly requires more terminal attention than the average live steam instrument because there are more parts.

The committee states that the reports to date indicate that the savings made in light service are small and increase as the capacity of the boiler is approached.

*Abstract of a report and a paper presented before the convention of the International Railway Fuel Associations held at Chicago, May 26 to 29, 1924.

Feedwater Purifier

The committee finds that only one road has a purifier under test together with the open type feedwater heater. This has not been in service for a sufficient time to determine the full benefit. The report from this road indicates that they are assigned to a bad water district and are showing improved conditions when compared with locomotives not so equipped. The feedwater enters the boilers at about 300 deg. F.

The purifiers are made up of cast iron bodies fitted with steel troughs. These troughs are filled with a series of dams. The feedwater passes into the purifier which is under boiler pressure through a standard boiler check and the water in going through the purifier drops some of its scaling constituents. From there it is carried to the bottom of the boiler barrel by two more troughs inside the boiler, one on each side. It has been found that a portion of the incrusting solids precipitate and are carried to the bottom of the barrel, from which they are removed through a perforated pipe connection to one of the blow-off cocks. The purifier troughs can be removed through the end of the purifier and cleaned.

No arrangement has been made for the gases which tend to accelerate corrosion to be left in the steam space or automatically removed before the water goes to the boiler, other than that provided by an open type feedwater heater. Tests have been made on railways where the open type of feedwater heaters was standard and it is reported that from 85 to 90 per cent of the oxygen from the feedwater supply has been eliminated.

Feedwater Heating in Terminals

It has been conservatively estimated that 20 per cent of all locomotive fuel is consumed at terminals and since none of the fuel burned at terminals is productive from a transportation standpoint, this loss is a serious one. That part which is incident to moving locomotives to and from the trains is to some extent unavoidable. Another terminal fuel loss is proportional to the time locomotives are held under steam. This can be lessened by giving the matter more methodical attention and by enlarging or rearranging locomotive terminal facilities to conserve heat in water from boilers blown down and return it to boilers as hot water when filled up in preparation for road service so that the motive power can move more promptly to and from the enginehouse. At least half the locomotive fuel consumed at terminals, however, is incurred in heating the water supplied to locomotive boilers that have been washed or refilled, and to this must be added the fuel burned in stationary boilers on account of the blower steam required by locomotives being steamed up. The extent of this loss depends on the temperature difference between water supplied to the boiler and the steam generated.

Fuel saving can be accomplished by filling the boilers with a mixture of steam and hot water at such pressure and temperature that a working steam pressure can be built up in the locomotive before the fire is lighted. The use of otherwise waste steam from boilers being blown down as a heating medium is a straight saving and the use of live steam as a direct feedwater heating medium increases the quantity of steam supplied by the stationary boilers but eliminates the necessity for using stationary boiler plant steam in the stack blower so that all of the heat in this steam is conserved. Tests of this direct steaming method are now under way and it is proposed that the committee extend the scope of its work for the coming year to include a study of the fuel economies resulting from this method and other approved practices for heating feed water at terminals.

The members of the committee are E. E. Chapman, A. T. & S. F., chairman; E. A. Averill, Superheater Company; S. H. Bray, Southern Pacific; J. A. Carney, Chicago, Burlington & Quincy; V. L. Jones, New York, New Haven & Hartford; A. G. Hoppe, Chicago, Milwaukee & St. Paul;

J. M. Lammedee, Worthington Pump & Machinery Corp.; H. A. Macbeth, New York, Chicago & St. Louis; L. P. Michael, Chicago & North Western; George S. Mikles, New York, Ontario & Western; George E. Murray, Grand Trunk Western; L. G. Plant, National Boiler Washing Company, and J. M. Snodgrass, University of Illinois.

Discussion

The discussion of this report indicated that defects in the design and construction of early types of feedwater heaters have been largely corrected in present designs. One member from the Southern Pacific stated that this road has 187 feedwater heaters of the open and closed types in service, experience showing that both types have successfully passed the experimental stage. The member commented particularly on the reduction in the number of water stops possible with feedwater heater equipped locomotives owing to the return to the tender of 1,500 gallons out of every 10,000 gallons of water supplied.

P. O. Wood, assistant superintendent of motive power of the St. Louis-San Francisco stated that feedwater heaters of both types used on the Frisco are efficient, have developed no excessive maintenance cost, and have been in service 12 months with very satisfactory results. He said that the closed type of heaters is washed once a month, this being at the time of the monthly inspection. Experience shows that the washing operation is simple and can be readily handled while doing the other work performed on the locomotives at this time. A member from the Santa Fe stated that operation of the closed type of heater in bad water country developed that the feed temperature of 240 deg. F., with a clean heater dropped to 205 deg. after the locomotive had made about 1,200 miles.

As a result the washing period is based on mileage and 1,200 miles has been selected as it is not desired to have the feedwater temperature drop below 205 deg. F.

There was considerable discussion of the exhaust steam injector, J. B. Hurley of the Wabash stating that, in his experience, the exhaust steam injector works satisfactorily as long as there is no change in cut-off or throttle opening. Otherwise water is wasted at the overflow. Mr. Hurley stated that the injector must be made to regulate itself automatically before it can be a success. Another member from the Kansas City Southern said that the loss of water at the overflow was frequently occasioned by too high a back pressure caused by the engineman lengthening the cut-off in anticipation of a grade. This was the fault of the engineman and should not be charged against the exhaust steam injector.

Oil and Coal as Locomotive Fuels

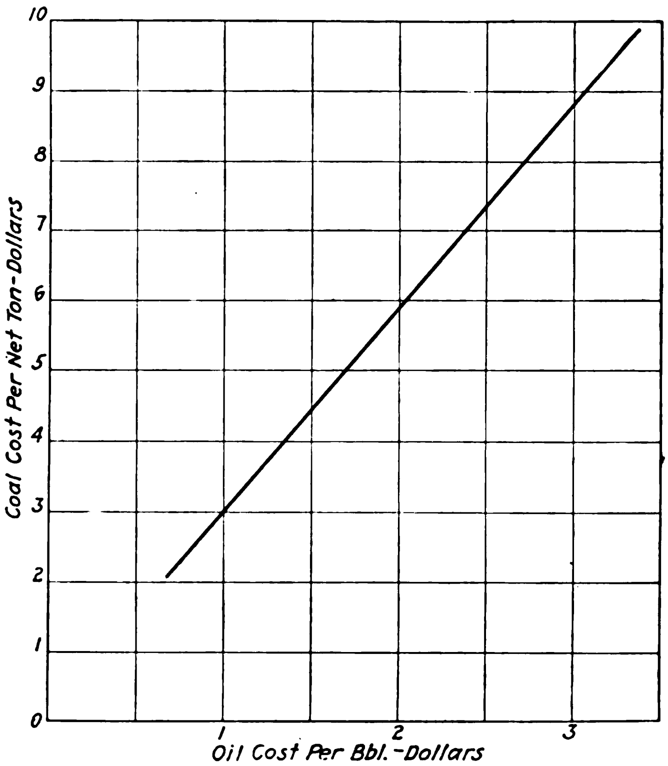
By M. C. M. Hatch

Mechanical Superintendent, Missouri-Kansas-Texas, Dallas, Tex.

The fuel, whether it be oil or coal, that will give the greatest amount of work at the draw-bar for every dollar expended is the one to use. When we buy a ton of coal or a barrel of oil, the feature of interest is the number of heat units obtained for the money. The average B.t.u. content of bituminous coal used for locomotive fuel is about 12,500 per lb. and for oil this figure is 18,500 per lb. Oil weighs 7½ lb. per gal. and 180 gal. of oil will therefore contain the same number of heat units as one short ton of coal. Relative boiler efficiencies must be taken into account, however, before any such comparison is of value and, from the best test figures available it appears that, with coal, we can look for a combined efficiency of about 62.5 per cent, while with oil this figure becomes 75 per cent. With due consideration of these relative figures the equivalent heat value of 2,000 lb. of coal is the same as that of 150 gal. of oil, The American Railway Association has recommended that, in order to establish a uniform basis for comparison, a standard equivalent figure of 160 gal. to the ton be used.

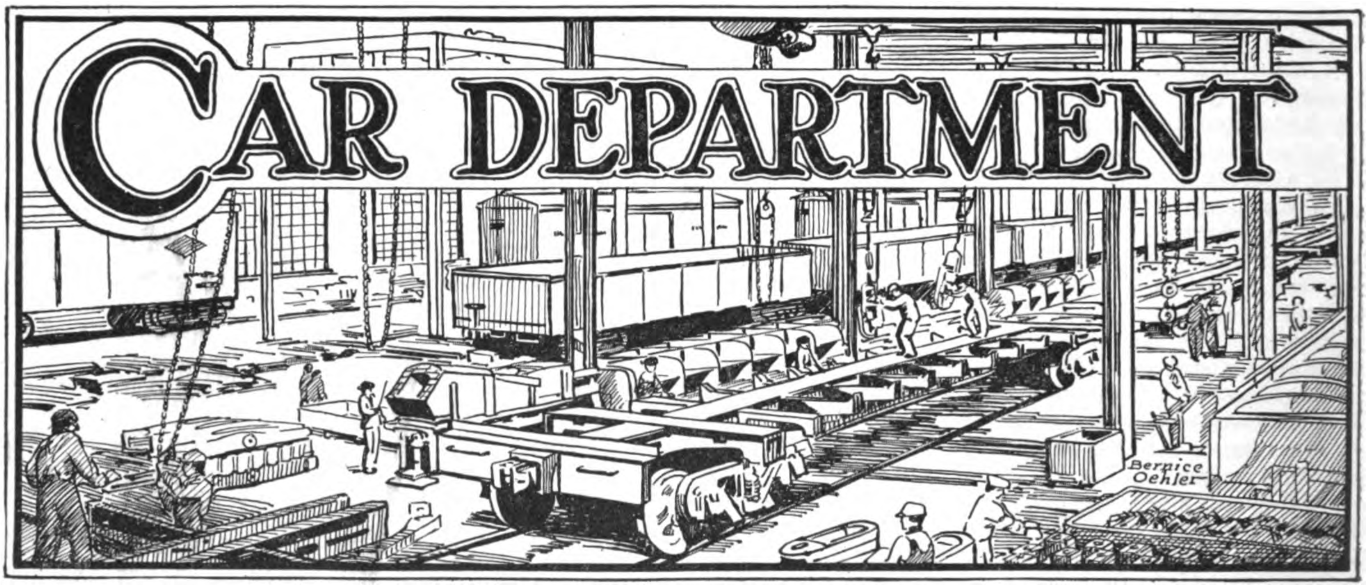
Locomotive boiler maintenance, when oil fired, has been discussed a great many times and decided opinions expressed to the effect that oil shortens the life of the firebox, other opinions being as strongly stated that this is not the case and that no additional expense need be feared. Personally, I favor the latter view. If we base our figures on the actual work done by the locomotive there will be no appreciable difference in boiler maintenance between oil and coal firing.

The cost of converting from coal to oil burning is influenced by numerous factors and for large modern power the net cost is found to be about $1,500 a locomotive. It is not easy to determine exactly what will happen to operating costs if oil be substituted for coal. Fewer engines will be needed to handle a given tonnage or the same number can handle a greater tonnage. Locomotives can stay out of the enginehouse a greater proportion of the time and long runs are possible that could not be made with coal. For example, the M.-K.-T. is running large Pacifics through in heavy, fast passenger service from Franklin, Mo., to San Antonio, Tex., a distance of 876 miles, five crews handling the engine. With this long run in effect for several months, the results attained have been most satisfactory.



Curve Showing "Balance" Prices Between Fuel Oil Per Bbl. and Coal Per Net Ton, Both on the Locomotive Tender

For any railroad contemplating the possibility of a changeover from coal to oil or the necessity of changing back from oil to coal, the thing to be determined is the balance in price between the two fuels. With coal at $5 a ton, on the tender, what price oil per barrel will develop the same amount of work or, with $1.25 oil how much should one pay for coal before seriously considering a change? The curve shown indicates, in a general way, where this balance will fall. This has been calculated on the basis of a careful consideration of all the factors involved. For all practical purposes, this curve shows that when the price of oil per barrel on the tender decreases to less than one-third the price of coal per ton on the tender the changeover from coal to oil or the reverse should be considered. This curve was drawn with the due consideration of relative boiler efficiencies, stand-by and other losses.



Maintenance the Key to Hot Box Prevention*

Thorough Inspection Enables the Carman to Anticipate Approaching Trouble

By M. S. Roberts

THE subject of hot boxes is an old one, as old as the railroads, but, unfortunately, forever new. Hot boxes will undoubtedly be a source of serious trouble until there is a radical improvement in the design of journal bearings and journal boxes. Such a change will involve great expenditures, almost prohibitive at this time.

The problem which railroad mechanical department supervising officers have to face is, therefore, means and methods by which the present standard parts can be maintained so that hot boxes will be kept at a minimum.

Contrary to ideas too frequently expressed by men who should know better, every hot box has a cause. And it is a waste of time to explain causes after the event when in most every case the event would not happen had proper preventive measures been taken.

The suggestions to be given are based on actual experience covering several years in close contact with this subject at one of the largest terminals in the country where every kind of traffic is handled in large quantities, and are treated under three general headings.

Regular Inspection of Journal Boxes and Contained Parts, Including the Packing

First—Passenger cars in through service.—Such cars must be inspected carefully at each originating terminal. If any box is found to be hot or above a good running heat upon arrival of the train, such box must be chalk marked for special attention when the train is placed in the storage yard. There may be a condition gradually becoming serious which will be caught in this manner, which might otherwise be overlooked when the regular yard inspection is made later after the journals have had time to become cold. In the storage yard close attention is given to the condition of all parts from the journal box itself through all the contained parts to the packing. The following details are covered: Fit of journal box in pedestal; journal, especially its size; journal bearing lining and packing. In case of the slightest doubt as to the condition of the journal bearing the box should be jacked, bearing removed and inspected. Before the box is jacked down again, the fit of journal bearing wedge on roof of box should be checked. The packing must not be allowed to remain in box if it is dirty or partially destroyed. If it is in good condition, it must be leveled all the way back and, if dry, given a small amount of free oil.

Second—Passenger cars in local service.—If all such cars are given the thorough inspection and attention outlined above (for cars in through service, once each week), it has been found that they will run with almost no trouble. The inspector indicates time and place of such inspection with a suitable chalk mark on the needle beam of the car. This facilitates the work and insures against cars being cared for within or beyond the prescribed period.

In very cold weather it is important that extra men be assigned to assist the regular force of box packers and inspectors. More time is needed to loosen up the waste which is sometimes found partly frozen, and more repacking is necessary at such times. It is also important to open the boxes of local cars more frequently than once a week in the cold weather, not only because of the danger of frozen packing, but also to replace packing which is removed by irresponsible or mischievous persons for the purposes of starting fires or thawing out steam pipes.

Condition of Journals, Bearings, Boxes, Wedges, Etc., When Wheels Are Changed

When it is necessary to change wheels, the most careful attention is given to those parts mentioned in the above title. Standard practices of the railroad (which are more rigid in these respects than the A. R. A. rules) are used to check journal measurements; that is, diameter of journal,

* Awarded first prize in competition on hot box prevention which closed March 1, 1924. The prize awards were announced in the *Railway Mechanical Engineer* for July, 1924.

length of journal, thickness of collar and whether straight or tapered. But the condition of the surface of the journal is of the utmost importance and here is where the greatest of care has to be taken. If there are any marks on the journal which cannot be removed with medium sand paper, the journal must be trued. Under no circumstances is the use of emery cloth on journals permitted. Second hand journal bearings are never used when wheels are changed. The lining of the new bearing is filed in order to insure removal of any abrasive particles from its surface. The bearing is also spotted to the journal in order to insure an initial crown bearing. At the time the wheels are changed, the pedestal bearing of journal box is checked and, if the amount of play between pedestal and box is excessive, necessary corrections are made.

Another item taken care of at this time is the bearing between roof of journal box and crown of journal bearing wedge. The importance of providing a lateral rocking surface between these two parts is frequently overlooked. In connection with this job, the condition of the other boxes on the car which is receiving the new wheels is carefully noted and whatever may be necessary to put the car in first-class running condition is done. Of course, the boxes of the new wheels are packed with new dope and frequently it is found advisable to repack the entire set of boxes. A final check of the shop work on wheels is made by inspecting the boxes of the new wheels immediately after the car is moved to the storage yard for its make-up in a train. If the work has not been done properly, one or both of the new journals will show signs of heating even in this comparatively short movement.

Preparation of Journal Box Packing

It is not the purpose of this article to discuss comparative merits of various types of journal box packing, the assumption being that good waste, with proper resiliency and of high capillary power, is being furnished. However, the proper soaking and draining of the dope is a most essential factor in the matter of satisfactory journal box conditions, and, therefore, care must be taken to have this work done in accordance with the well-known standard practice. The importance of properly applying dope to journal boxes should not be overlooked, for the finest of material cannot function if it is not placed so that it can transmit the greatest possible amount of oil to the surface of the journal.

Cars in through passenger service should be repacked every four to six months and one of these times should certainly be just before the beginning of winter. Cars in local service should be repacked every six months if possible.

Freight Train Cars

The foregoing discussion has dealt altogether with the handling of passenger equipment. Such careful attention cannot necessarily be given to freight equipment, but an effort should be made to handle such equipment in the same general manner because the loss of money due to delayed shipments can be, and frequently is, very great. Freight cars in order to be in good condition for a long run must be right leaving the originating point. It is, therefore, essential that they be carefully inspected immediately on arrival at which time any bad journals will be most easily found. In this manner cars requiring a change of wheels can be put on the repair track as soon as they are empty, instead of being reloaded and later cut out when half way over the division and then returned for a change of wheels. All journal boxes on outgoing trains should have the covers raised, journals and brasses inspected, packing adjusted or renewed if necessary, and some free oil added, as this is nearly always needed.

At intermediate terminals a running inspection is frequently all that can be made, but usually any car which is getting into a condition where trouble is imminent can be detected and taken out of the train for change of wheels. In some cases a change of journal bearing or repacking of the box will prevent further trouble.

Conclusion

In the foregoing article an endeavor has been made to touch upon the most important considerations in connection with hot box prevention. Perhaps nothing new has been said, but too much emphasis cannot be laid upon the importance of close inspection, honest maintenance and the use of first-class materials in the never-ending effort to keep hot boxes at the lowest possible minimum.

—— Car Construction

Relation of Key Connection to Coupler Action

By C. R. Harding
Consulting Engineer, Southern Pacific Company

It is an axiom of mechanics that relative angular movement between two connected members cannot take place unless the connection is sufficiently flexible. The old riveted wrought draft yoke was inflexibly connected through the coupler butt and the failure of this riveted connection was a frequent cause of break-in-twos. A glance at Fig. 1 shows the tremendous leverage which is exerted upon the two

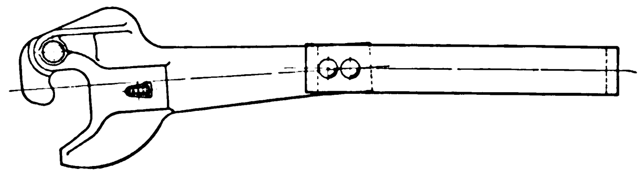


Fig. 1—Showing Leverage Exerted on Rivets by Side Swing

closely spaced 1¼ in. yoke rivets at every side swing of the coupler.

Vertical movement of the coupler tends to spread and bend the riveted yoke and to stretch the rivets as shown in Fig. 2.

The adoption of the present standard horizontal coupler key provided a device which solved the greater number of the problems involved in the development of an efficient connection between the coupler and the draft yoke. For the sidewise movement illustrated in Fig. 1 it provided a certain

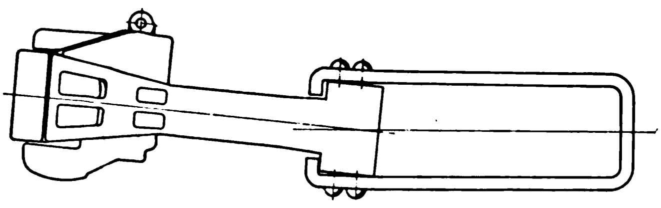


Fig. 2—Vertical Movement Spreads Yoke and Stretches Rivets

amount of clearance in the coupler shank key slot. This means merely the substitution of flexibility through the loose connection of the related parts instead of a form of connection which would have produced a true radial device. Nevertheless the horizontal key has proved remarkably satisfactory in the performance of its various functions.

The substitution of a vertical key or pin for the present horizontal key has frequently been proposed but before seriously considering a permitted departure from the existing standard connection, it would appear well to bear in mind that the horizontal key has other important functions than merely providing an effective tension connection between

the coupler and yoke. It certainly serves as the simplest means of maintaining the coupler shank in its proper position and affords in itself an adequate guide without the necessity for additional carriers, bolted or otherwise. The horizontal key also provides a positive emergency connection which comes into action in the event of yoke or draft gear breakage or of excessive wear. Surveys on old equipment show that almost invariably the coupler key frequently makes contact against the forward ends of the sill slots. The elimination of this safety stop might conceivably result in a great increase in the number of break-in-twos. The present horizontal key provides adequately for the vertical angular movement of the coupler, as the clearance in the key slot permits the key to angle slightly with reference to the yoke and also permits the coupler to move through an equal angle with reference to the key. This is shown in Fig. 3.

Any vertical key device with which the writer is familiar

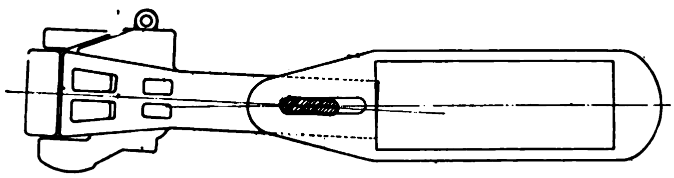


Fig. 3—The Horizontal Key Provides Adequately for Vertical Angular Movement

does not provide full key bearing under vertical coupler movement. Standard practice requires a clearance of ¾ in. between the top of the coupler shank and the striking plate. Sagging or worn coupler carrier irons might easily permit an appreciable movement below the horizontal plane. Vertical movement results when the car ahead enters or leaves a grade and also when empty and loaded cars are coupled together or where the coupler of one car is at the maximum height while the other is down to the permissible minimum. The behavior of a vertical keyed coupler under these circumstances is shown in Fig. 4.

The present A.R.A. standard 6-in. by 1½-in. horizontal coupler key meets all the requirements of service with the exception of the following theoretically desirable features:

(A) Under pull with the coupler angled horizontally, one side of the yoke is subjected to greater stress than the other.

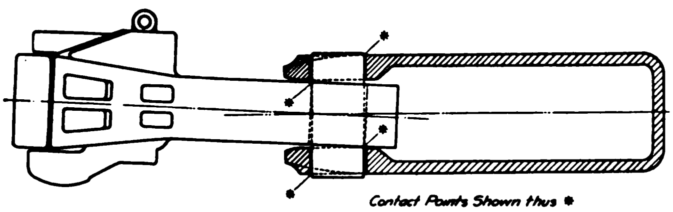


Fig. 4—Showing Lack of Key Bearing in Vertical Key Connection

(B) Under pull with the coupler angled horizontally, the bearing between key and coupler is to one side of the coupler.

(C) Under buff shocks with the coupler angled horizontally, there is not an evenly distributed bearing of the coupler butt on the draft gear.

So far as known, no practical difficulty has ever arisen on account of the above theoretical objections.

With the vertical key coupler, the following conditions will be obtained:

(A) Under pull with the coupler angled vertically, one arm of the yoke is subjected to greater stress than the other.

(B) Under pull with the coupler angled vertically, the bearing between key and coupler is either at the top or bottom of the coupler.

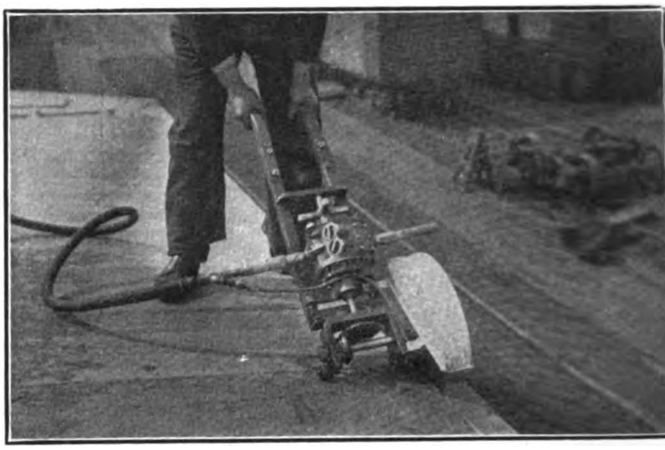
(C) Under buff shocks with the coupler angled vertically, there is not an evenly distributed bearing of the coupler butt on the draft gear.

The complete requirements for a coupler which shall accommodate itself to all service movements seem to be these: The use of a horizontal key for the purpose of maintaining the shank of the coupler in its proper position, and to provide a positive emergency connection between the coupler and the car underframe in the event of yoke or draft gear breakage; the maintenance of substantially uniform stress under pull in the key and both arms of the yoke regardless of coupler angularity, and the maintenance of substantially uniform contact between the coupler butt and the draft gear under buff regardless of coupler angularity.

Portable Trimming Saws

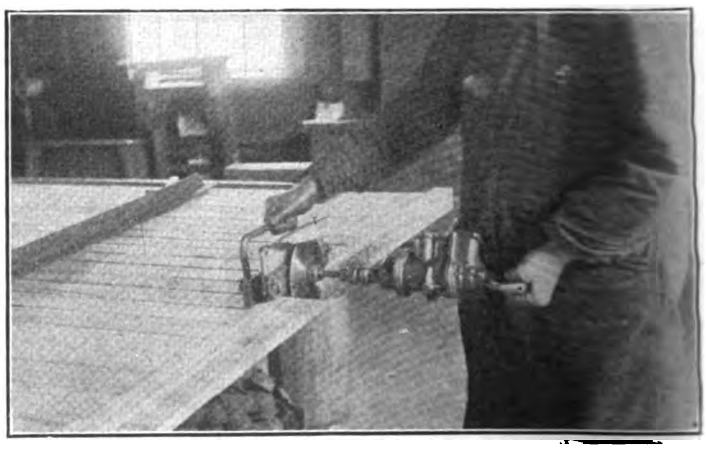
By E. A. Murray

THE two illustrations accompanying this article show the general construction and the use of two types of portable air operated circular saws which have been developed for use in trimming the ends from roof and door boards in wood car repair work. The simplicity of construction and the



The Large Portable Saw Effects a Great Saving in Time on Jobs Like This

adaptability of this device should particularly appeal to the car repair foreman, not to mention its time-saving possibilities. The illustration showing the larger of the two saws in use for trimming roof board ends gives an idea of the ease



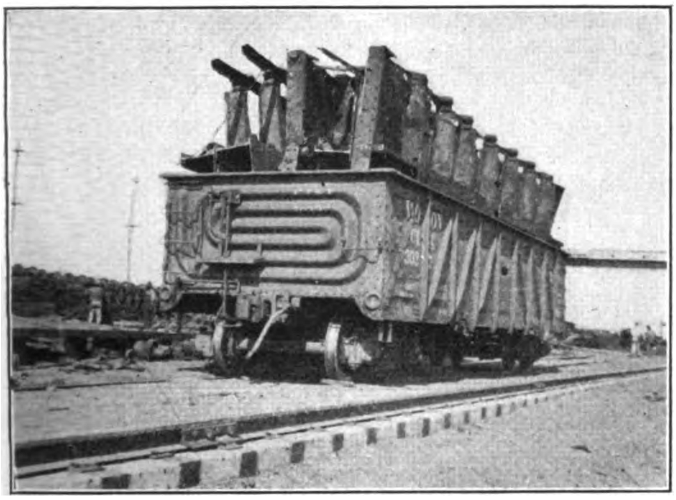
The Light Weight Pneumatic Saw Is a Handy Tool for Trimming Door Board Ends

with which this work may be accomplished. This operation alone formerly required 80 minutes when using a hand-saw, and by the use of the portable saw, the time has been reduced to 25 minutes.

Burlington Dismantles Cars at Eola Scrap Dock

Total Unit Cost of Scrapping 300 Steel Gondolas Amounts to Slightly Less Than $16 per Car

A FEATURE of unusual interest in connection with the scrapping of 300 steel gondolas, series 187,000, for the Chicago, Burlington & Quincy, was the arrangement to have their work done at the recently completed Eola scrap dock under the supervision of the Aurora, Ill., stores department. There was no intention to intrude on the province of the mechanical department in assigning this work to the stores department but in this case it happened that both the space and crane facilities for expeditious handling of the work were available at Eola, whereas the cars could not be scrapped in car shops and rip tracks on the system without interfering with normal repair work.



Scrap Sills Loaded on Car Ready for Delivery to the Dealer

There are several other reasons why it is a paying proposition to have this work done at the Eola reclamation plant. In the first place, the provision of ample crane service enables the trucks to be piled four or even six high, as shown in the illustrations, with a resultant big saving in ground space. Moreover, by cutting up the cars right at the scrap dock where all scrap must eventually be received before delivery to scrap dealers, at least one handling of the scrap is saved. All usable material is also segregated at the scrap dock, from which it can be shipped to various points on the system as required. Last but not least, the work of scrapping the cars is being done at less expense at Eola than would be required at most car shops and rip tracks, owing to the development of specialists who have greatly cut down the time required for the various operations.

Car Bodies Are Set on the Ground Ten at a Time for Cutting Up

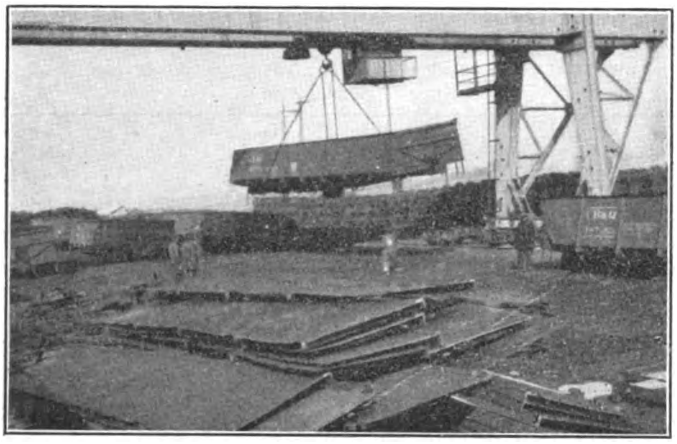
Description of Dismantling Operations

The work of dismantling cars is done by one foreman and a force of seven men, this force consisting of two operators

Space Is Saved by Piling the Trucks Six High

with oxyacetylene cutting torches, two operators with one-man rivet busters, two men who follow up the rivet busters and separate the car members, and one man who sorts out the usable material for the magnet. There is also a crane man and a ground man, a portion of whose time is charged to scrapping the cars. The cars are scrapped 10 at a time and the first 30 cars required 12 days, or an average of four days for each series of 10 cars. When a new series of cars is brought in, the entire force helps in disconnecting the trucks and placing the car bodies, after which each of the men takes up his own particular duties.

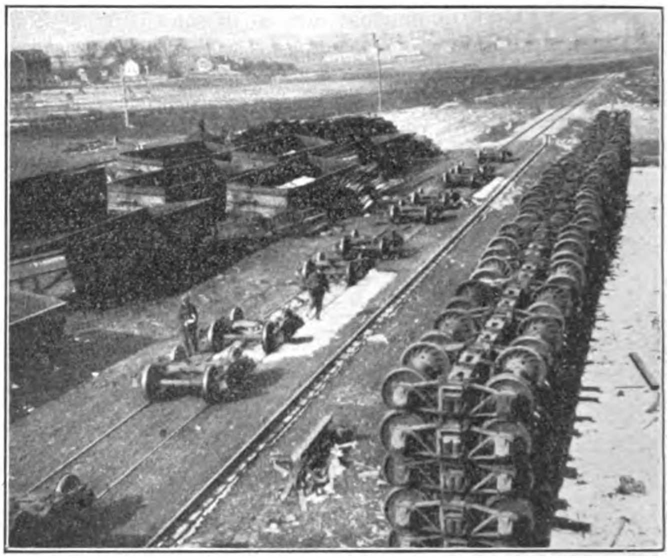
The first operation consists of lifting the car bodies from the trucks and placing them with the scrap dock crane on



Side Sections Cut with the Acetylene Torch Are Shown in the Foreground

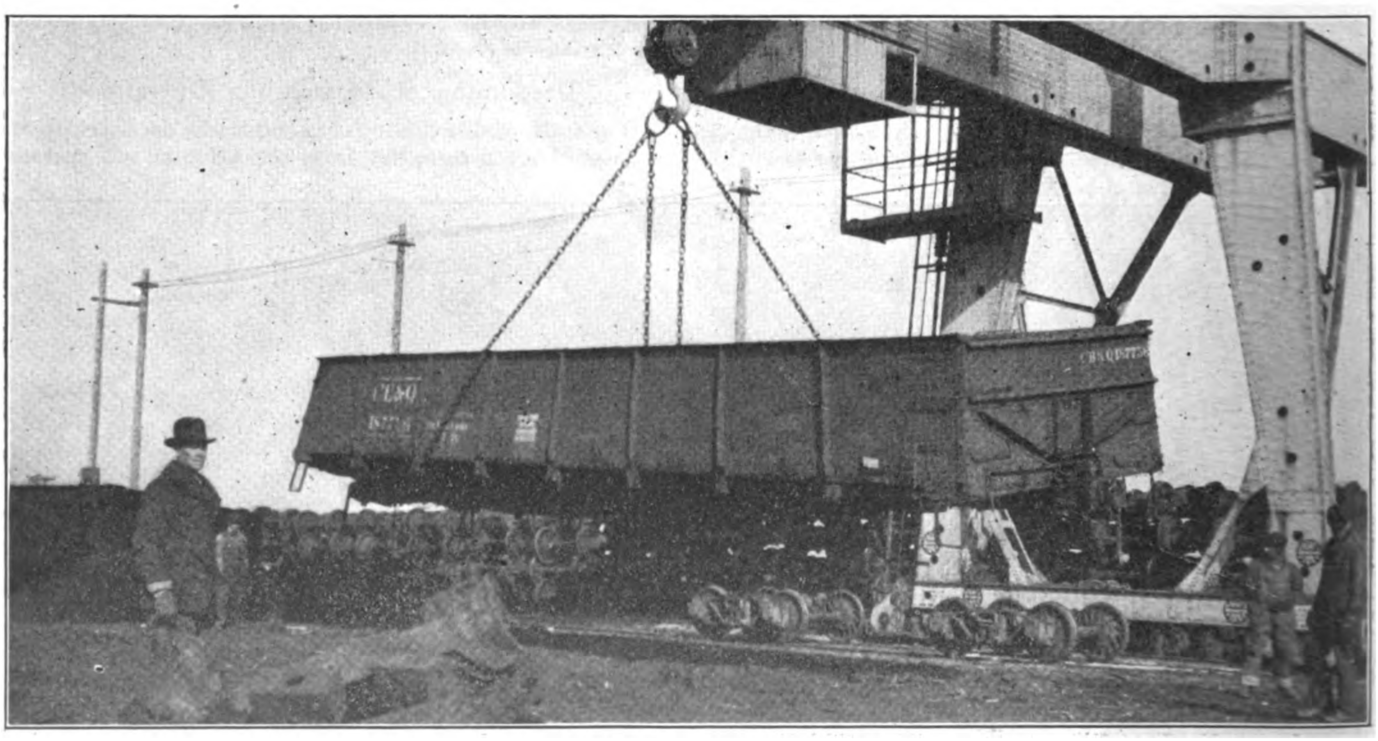
the ground where they can be readily reached for cutting up. The trucks are then picked up by the crane from the track and piled four, or in some cases even six high. The trucks and piled in scrap cars for delivery to the dealers. The center sills in these cars are practically all rusted out, but sound sections are cut out with the oxyacetylene torch and the channels saved for splices in steel center sills of other cars undergoing repairs at various shops on the system.

A detailed analysis of the cost of dismantling a single



The Entire Operation Is Conducted within Reach of the Scrap Dock Crane

series of 10 cars is given in the attached table in which all items of expense are covered except overhead costs for the crane facilities and ground occupied. It takes on the average 35 min. to lift and place the 10 car bodies and 65 min. to pick up the 20 trucks from the dock and pile them four high on the ground. The ground man referred to in the

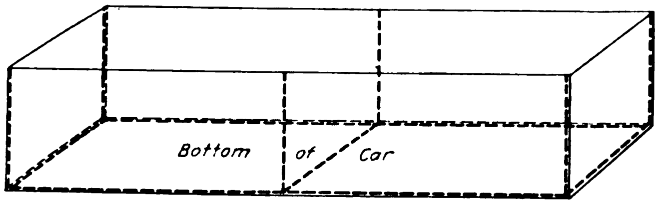


Car Bodies Are Readily Removed from the Trucks and Placed for Cutting Up, with the Scrap Dock Crane

are removed intact and not dismantled as they are to be used again in the construction of new cars. After placing the car bodies, they are cut apart along the dotted lines indicated in the sketch, the various sections then being readily handled analysis is provided largely in the interests of safety to give signal indications to the crane operator and to see that no one is injured in handling the material.

Referring to the analysis it will be noticed that the total

cost of lifting the 10 car bodies was $1.45 and picking up and piling the trucks $2.71. The labor cost of cutting the bodies apart amounted to $80.15 with the additional substantial charge of $60.45 for oxygen and acetylene gas. The grand total cost for the 10 cars was $158.76 or a unit cost of $15.88 per car. The scrap was sold for $882.01, the value of the good material reclaimed being $152.00 and the value



Car Bodies Are Cut with the Acetylene Torch Along the Broken Lines

of material needing repair $681.68, making a total of $2,715.69. The difference between the value of scrap and reclaimed material in these cars and the cost of dismantling them was therefore $2,556.93 or $255.69 per car.

COST OF DISMANTLING TEN STEEL GONDOLAS AT EOLA RECLAMATION PLANT

Lifting car bodies from trucks and placing on the dock, using the crane.			
35 min. current for crane	at $1.45 per hr.	$ .84	
35 min. crane operator	at .60 per hr.	.35	
35 min. ground man	at .45 per hr.	.26	
			$1.45
Picking up the trucks from the dock and piling four high on the ground.			
65 min. current for the crane	at $1.45 per hr.	$1.57	
65 min. crane operator	at .60 per hr.	.65	
65 min. ground man	at .45 per hr.	.49	
			2.71
Labor cost of cutting apart and stripping good material from car body.			
107 hours laborer	at $0.40 per hr.	$42.80	
83 hours laborer	at .45 per hr.	37.35	
			80.15
Material.			
13 tanks oxygen, 2,860 cu. ft.	at $1.60 hd. cu. ft.	$45.76	
2 tanks acetylene, 544 cu. ft.	at 2.70 hd. cu. ft.	14.69	
			60.45
Supervision.			
Foreman 28 hours	at $0.50 per hr.	$14.00	
			14.00
Grand total			$158.76
Total cost per car			15.88
Credits.			
Value of scrap sold		$882.01	
Value of good material reclaimed		152.00	
Value of material needing repair		681.68	
			2,715.69
Cost of dismantling			158.76
Net saving for 10 cars			$2,556.93
Net saving for 1 car			255.69

Photographs and data presented in this article are made available through the courtesy of C. J. Mackie, storekeeper of the Chicago, Burlington & Quincy at Aurora, Ill., directly in charge of the Eola reclamation plant.

Improvements in Passenger Car Construction

Work of Building and Maintenance May Be Facilitated by Adopting Uniform Equipment Designs

By C. E. Barba

EXCESSIVE weight of passenger equipment affects the cost of haulage unless the total load is within the limits of the capabilities of the prime mover. This seems to be true so long as we neglect the factor of speed. Rapid acceleration and retardation, however, demand the lowest weight consistent with comfort and safety.

To obtain reliability, safety and strength with economy are the ends sought. These features are usually obtained by the introduction of load-carrying side members, supported by an underframe capable of sustaining end shocks, a roof construction that will sustain the weight of the car body and an end construction which will resist telescopic action. There are, therefore, a number of ideals to be considered in up-to-date equipment.

A unit section between side posts should be adopted comprising two or three windows to enable the designer to obtain cars of various standard lengths by the addition or elimination of these units.

Importance of Underframe Construction

The underframe is the great vital feature of passenger equipment. Upon it depends the success or failure of the design more than any of the other members. The present designs of underframes may be divided into two classes of load transference: First, those distinguished by the absence of all bolsters, in which the static lading is all transferred at various intermediate points to the center sills, which in turn places it directly upon the center plates which are riveted to them. This type presupposes a strong center sill and may make use of a weaker side girder. The second class is those in which all the sills carry the load to a bolster. This type is characteristic of a majority of the equipment now in service.

The first type lends itself particularly to those cars which have side doors, such as the postal and baggage types. A support may be placed directly under the aperture for load transference to the center sills and the side will not need to be strengthened by a frame construction carrying the load up to the eaves and over the door.

The underframe member should be standardized by designing for the maximum length of car and, when reducing the length for shorter cars, a central unit may be removed and, when advisable, the thickness of the cover plates reduced.

The riveting can be anything that is consistent with good design, but in the central unit section it must be a constant function of the distance between posts so that the removal of such a unit will not alter the spacing. The underframe should be built with a view to clearances required for both steam and electric service and hence designed to take either motor or trailer truck.

Likewise, the standardization and location of equipment hangers, battery boxes, steam and air piping, brake rigging and false floor construction require most careful consideration, as the variety of installations, the initial cost of application and subsequent maintenance are out of all proportion for the services intended.

The adoption of a standard end, including the platform

*A brief abstract of a paper presented at a meeting of the New England Railway Club, Boston, Mass., April 8, 1924.

and vestibules, should be given consideration. The anti-telescopic features should be simplified and increased by transferring more of the load to the side members.

Standard End and Roof Construction

The form of roof construction best adapted for strength, lightness and ease of repairs is one of a semi-circular construction. U-shaped carlines are preferable, with steel sheets rolled to conform thereto. All joints should be covered with splice plates.

To facilitate a more rigid end construction, it is suggested that the present form of hood construction be eliminated and the semi-circular roof continued to the end of the vestibules. This would enable the application of a semi-circular, channel shaped pressing to be applied to the end of the roof and attached to the vestibule, which undoubtedly would decrease the wind resistance.

The elimination of the so-called "clear-story," or upper deck, is recommended as it is no longer required for the purposes for which it was originally intended. Its primary purpose was for the suspension of oil lamps and its secondary purpose for ventilation. This form of construction is expensive, considering sash frames, sash, screens, deck plate, carlines and inside mouldings. The elimination of all of these items, with the exception of a modification of the carline to conform to a semi-circular roof, decreases the weight, increases the strength of the roof as a whole, and assists in maintenance.

Change the Location of the Belt Rail

The present location of the belt rail where it is on the outside of the side sheets below the window sill should be eliminated by applying the rail in pressed recesses in the side posts, the depth of the recess being equivalent to the thickness of the belt rail.

Such an arrangement would permit the procurement of level side sheets to cover one panel only, or from the center line of one post to another with reasonable clearance between. The splice plate to cover would consist of both the post cover between the window openings and the joint of the side sheets, extending from the letter board to the bottom of the side sill. This feature has a two-fold purpose; namely, to do away with buckles in the side sheets covering two or more panels, and to facilitate repairs when the car has been wrecked or side swiped.

The window openings in the side frame may vary for construction purposes from 1/4 in. to 3/8 in. both in length and width, as the use of either an aluminum or pressed steel window frame, having suitable flanges and applied from the outside, will take care of these variations. This form of construction would require a stationary sash, thus eliminating all hardware and furring strips. The latter is quite awkward to apply on account of the location.

Proper System of Ventilation and Seating

A ventilating system to take care of the conditions previously outlined should be provided, as undoubtedly more attention has been given in the past to the development of heating passenger coaches than to ventilation. These subjects are closely interwoven and they should be considered together instead of separately.

In this connection, it might be well to mention for those directly interested in the subject of ventilation and heating of railway passenger cars that an exhaustive study on this subject was presented by K. F. Nystrom, engineer of design, Chicago, Milwaukee & St. Paul, before the Canadian Railway Club of Montreal, Canada, on February 12, 1924.†

The reversible seats now in common use should also be eliminated, thereby simplifying not only the construction, but likewise their application, substituting instead seats placed back-to-back. This would permit the application of a steel gusset between the seat backs and attaching them to the side post and floor support of the underframe. This form of construction would increase the transverse stiffness of the side framing and prevent in a large measure the buckling of the side members due to collision.

All interior finish should be made up of veneer, the core of which should be fireproof. The present practice of having a steel inside finish involves considerable labor for its application and necessitates lining for seasonable climates and adds nothing to the strength of the car body as a whole.

Why the All-Steel Car?

Theories have been advanced that the ethics of the service demand an all-steel car. Why? In tunnel service the danger from fires is greater than from collision and the necessity for non-collapsible fireproof cars for such service is evident. On the other hand, the necessity for cars of this type is just as important for our long distance, high speed service, where luxurious buffet, dining, parlor and sleeping cars have provided comforts at the expense of increased weight. To meet the requirements of these fast schedules with heavy trains, the modern passenger locomotive of large tractive force has been developed. Considerations of safety demand that the passenger equipment of such a train be of uniform strength, capable of resisting the greater shocks in service and accident due to the greatly increased kinetic energy of the moving unit.

The past twenty-one years have demonstrated that all-steel cars may be modified to the extent of using wood in some form for the inside finish, without destroying the advantage a steel coach offers as a measure of safety.

The design of the saloon and lavatories should be simplified to be built either single or in combination with switch lockers and water coolers. The cost of manufacture of enclosures of this character, when they are made of steel and adhere to the finish required as part of the interior arrangement, is not consistent with productive methods now in vogue.

Standard Type Battery Boxes and Flooring

The size and type of battery boxes could be standardized, provided the size of batteries, irrespective of the system used, were alike. It is also considered good practice to have one size of battery box for all passenger cars, the size to be determined by the maximum number of batteries to be used on any one car.

Since the usual type of flooring consists of some plastic medium laid on corrugated, keystone or other forms of metal sheets, its life depends largely on the mixture. Wear in the aisle is inevitable and it is proposed to lay the width of the aisle separate from the rest of the floor by placing narrow strips of asphaltum between the aisle proper and the main floor. Such an arrangement will facilitate the re-laying and take care of expansion and contraction in a transverse direction.

Standard Methods of Painting

All railroads are interested in securing the maximum revenue from their equipment which technically, means no shopping. This introduces a problem of drying paint, which has not been given the attention that such a subject requires. Co-operation with the manufacturers relative to the introduction of a system that will minimize the time required for drying is desirable. Furthermore, it is not believed that the control of temperatures for air drying solves the problem from a productive standpoint.

Drying ovens are a necessity as the following figures would

†An abstract of Mr. Nystrom's paper was published in the March and April, 1924, numbers of the *Railway Mechanical Engineer*.

seem to indicate. This is the actual time for drying one coat only.

	Air drying time, hours	Oven drying time, hours
Primer	24	3
Putty and glaze	24	3
Surfacer	12	3
Color	24	3
Varnish	24	3

This system eliminates all weather conditions, extra pick-up work due to dirt or abrasions and provides for a continuation of the subsequent processes. Under present conditions air dried painting requires attention approximately every eighteen months, whereas with the oven the life and durability has been increased two and one-third times.

Importance of Proper Design

The success of any equipment depends on the design, but unfortunately the lack of time usually available between starting the design and the placing of an order has seriously hampered some designers. The resulting trouble in the shop owing to oversight in design, has given the subject a black eye on some roads.

It is unfortunate that the managements do not usually foresee the difficulties involved in such a problem, and allow at least a year to the designers to evolve a design which will not only be satisfactory for the initial order, but from which future orders of cars of different lengths and character can be constructed more expeditiously. The research work necessary to determine the possibilities of an all-steel equipment, for ease of manufacture and maintenance is enormous, but undoubtedly the labor thus spent is well repaid by the decreased cost of maintenance and interchangeability, so that after the first development any type of car can be designed at short notice with a larger degree of accuracy than has ever before been attempted.

The ideal car will never be built, but the lighter car of simple and easy, though sturdy construction that will carry the greatest number of passengers most comfortably on the least number of journals and always be ready to serve, is the type of car desired.

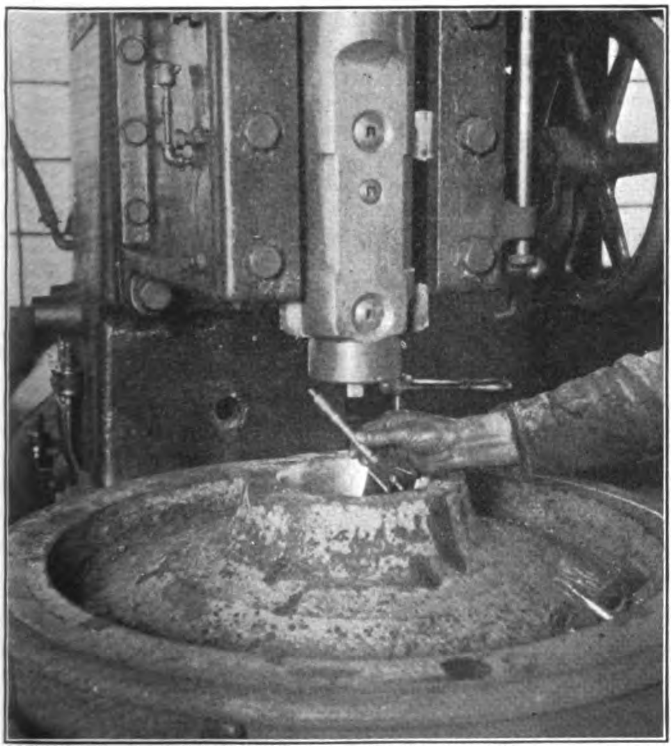
Application of Micrometers in Railway Shops

The Output and Quality of Work in the Car Shop is Improved by Their Intelligent Use

Part I

By M. H. Williams

In order that a man may work economically it is necessary to supply him with machine tools that are up to date in so far as design and strength are concerned and they should be kept in the best of condition. It is unfortunate that the railways are not always in a position financially to discard machine tools every time a more modern design is brought out by the manufacturers. It is, however, a very open question if, in most railway shops, money could not be spent to better advantage for the purpose of improving the minor devices, hand tools, gages, fixtures, etc., than for the modern machine tools such as lathes, planers, shapers and other necessary machines.



Proper Way to Apply Inside Micrometer Callipers When Measuring the Bore of a Wheel

The more advanced railway shops endeavor to arrange the work and supply measuring devices so that the machine operators do not have the occasion to leave their stations for the purpose of taking measurements. This makes it possible for the operators to increase the output by passing from one job to another with a minimum delay, and while the investment in the smaller devices is increased, the investment in the more costly machine tools is reduced because fewer are required.

Providing the necessary measuring equipment has made it possible to set limits or tolerances to govern the amount that should be allowed for the various grades of fitting according to the most modern practices. These limits should preferably be given in thousandths of an inch and are generally measured with micrometer calipers. There is no question but that limits should be set to govern the amount that should be allowed for drive and running fits for all motion parts of the locomotive. Without the use of micrometers and a few gages it is hardly possible to accomplish the desired results either when setting the limits or in the shops when working to them.

Measuring Car Wheels and Axles

It is estimated that 75 per cent of the new car axles turned and the wheels bored by car manufacturing concerns are measured with micrometers. Several railway shops are following this practice when repairing these parts. The general plan followed when repairing car wheels and axles in micrometer equipped repair shops are as follows. When

repairing the axles, the journals and the wheel seats are turned barely enough to remove the low spots and true the surface without respect to their diameters. The lathe hand rarely makes use of calipers when turning. The wheel seat is then measured, either when in the lathe or after removal, with micrometers similar in general design to that shown in Fig. 1. The practice is to measure each individual wheel seat at both ends and at the middle, thus making a total of six measurements on each axle. The average diameter of each is then marked with chalk on the axle adjacent to the seat. If the measurements made on a single wheel seat do not vary more than .004 in. the axle is considered satisfactory. If there is a greater variation, the axle is again turned. Owing to the large number of measurements that must be made in a day's work, attachments are, to good advantage, added to the regular micrometers in order to reduce to a minimum the time required for each measurement. These special micrometers shown in Fig. 1 are made up of the regular commercial article, to which is added the arm *A*, holding the squaring anvil *B*, which is set exactly square with the regular caliper anvil and screw. The gage points *C*, *D*, *E* and *F* are made so that the distance from the center line of the anvil and the screw is approximately equal to the radius of the axle to be measured. For a caliper having a range from six to seven inches, the faces of these points are spaced from the center line of the caliper frame 3 1/16 in., 3 3/16 in., 3 5/16 in. and 3 7/16 in. In order that these points will be properly located, each is provided with a spring detent that engages in a single conical hole drilled in the micrometer frame shown at *G*. When the desired gage point is moved to the proper location its detent drops into the conical hole which holds it in place. The purpose of these gage points is to insure the caliper being set so that the anvil and the micrometer screw will come central with the center line of the axle. When measuring an axle between 6½ in. and 6¾ in. diameter the gage point for that diameter is moved so the detent is in the conical hole. Placed on this size of axle with the gage

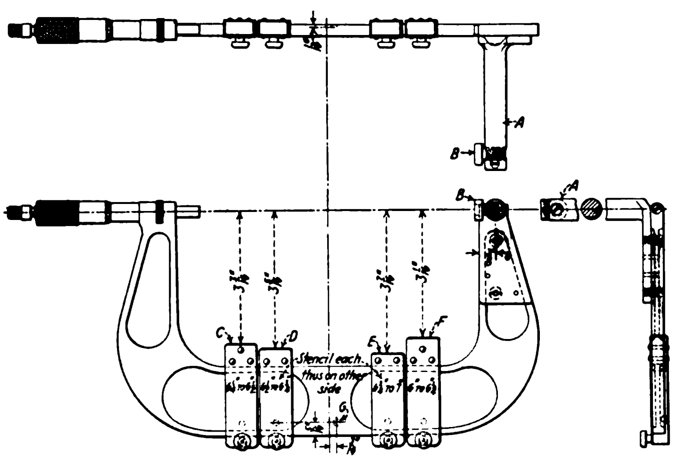


Fig. 1—Micrometer Caliper with Special Attachment for Measuring Wheel Seats on Axles

point resting against the axle at once sets the caliper so the anvil and the screw are practically in line with the center line of the axle. The possible error is about ⅛ in. on each side of the center line. The anvil and screw being each ¼ in. in diameter, this amount off center does not affect the measurements. This is illustrated in Fig. 2. Circles 6 in., 6¼ in., 6½ in., 6¾ in. and 7 in. in diameter are shown, each resting against the anvil *H*. Each circle also rests against one of the gage point surfaces.

A micrometer equipped with these gage points, in measuring eliminates all moving of the caliper up and down or feeling for the proper location. When measuring, the anvil and the squaring point *B* are held against the axle, also the gage points *C*, *D*, *E*, or *F* rest on the axle. Under this condition the caliper is located square with the axle, and the anvil and the screw are approximately in line with its center. Owing to this setting it is only necessary, when making a measurement, to turn the micrometer screw to the axle, remove the caliper and read the sizes. An inspector accustomed to the use of the caliper can readily make the six measurements required on one axle and also mark the sizes on each in ½ min., which will be found less than the time required measuring with machinist's calipers. The sizes marked with chalk on the axles are made use of when boring the wheels.

Advantages of Micrometer Calipers

There are four principal advantages in using micrometer calipers as compared with machinist's calipers or snap gages. These are the general toning up of the shop, the superior fit-

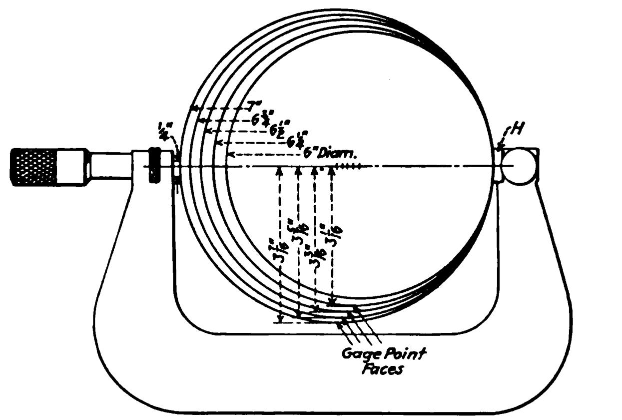


Fig. 2—Diagram Showing How the Anvil and the Screw of the Caliper Are Practically in Line With the Center of the Axle.

ting of the axles in the wheels, less time required to caliper, and time saved when boring the wheels. We will now consider these points in the order mentioned.

Toning up of the shop—Calipering and measuring each wheel seat at three points with micrometer calipers, at once shows up defects in turning or defects in the axle lathes. These machines receive very hard usage owing to the low cost of doing this work and the large output demanded. The wear on the bed or ways must, of necessity, be excessive, especially where the journals are burnished. This is very undesirable owing to the possibility of not fitting the wheel in a proper manner. A taper or irregular wheel seat will not make a proper force fit in a wheel that has been bored straight.

To turn each wheel seat to an exact diameter from end to end adds greatly to the costs and is a refinement which in the light of past experience is not warranted. There is, however, a limit of taper that can be allowed which in a number of shops has been set at .004 in. That is, one end of a seat may be .004 in. larger than the opposite end, which is considered perfectly safe for cast iron wheels and in most cases for steel wheels, although a closer limit is desirable for the latter. Measuring each axle with micrometers as it comes from the lathe at once shows if the turning has been done in a proper manner. If not turned within the limits it goes back for another turning. Under this condition the lathe operator knows just what he must do and the question of individual judgment between the lathe operator and the person inspecting is entirely eliminated.

Another point enters here. As previously mentioned, axle lathes are subject to excessive wear and are liable to get out of true, or the lathe centers may become worn. Either condition may cause defective turning even where the operator uses ordinary care. Where a number of defective wheel seats are turned on any one lathe it should be examined for possible inaccuracies. This is readily done by taking a light cut

over a wheel seat or journal without changing the adjustment of the turning tool during the turning operation, and afterwards measuring with micrometers.

It can readily be seen that this toning up of the shop which will follow with the use of micrometer calipers will make it difficult for a defective wheel seat to get out of the shop and as a result there will be a minimum number of wheel failures to explain.

Superior fitting of axle wheel seats in the wheel—This is a question that hardly calls for explanations. Every wheel shop foreman knows that the wheel seats will fit the wheels more perfectly with less liability of coming loose or bursting the wheel where the seat is practically of one diameter from end to end. The use of micrometers will bring about this result.

Less time required to caliper—Experience has shown that wheel seats are measured in less time with micrometers than with machinist's calipers. However, the question of time is of secondary importance. The principal advantage is gained from the fact that the exact diameter is at once shown by the micrometer and can be marked on the axles, this diameter being made use of in boring the wheels.

Micrometers for Measuring Diameter of Wheel Bore

Time saved when boring wheels—Car wheels should be bored of one diameter from end to end of the bore. This is a condition readily obtained with the modern double-bit adjustable boring bars having micrometer dials such as are now on the market. These bars are so perfected by the use of micrometer dials that car wheels are readily bored to the required diameter within a limit of less than .001 in. However, the cutting tools in these bars will wear, which makes it necessary to check the size of each wheel bored with micrometers. This measuring is quickly and accurately made with the inside micrometer caliper shown in Fig. 3. It is made up of an ordinary commercial inside micrometer shown at *A* which fits loosely in the base *B*. When measuring the diameter of a wheel bore, the base *A* is held against the bore which lines the micrometer square and central with the bore. It is then only necessary to turn the micrometer screw out to the bore size, remove and read the size. This eliminates side and end feeling which results in accurate measurements being made in a few seconds.

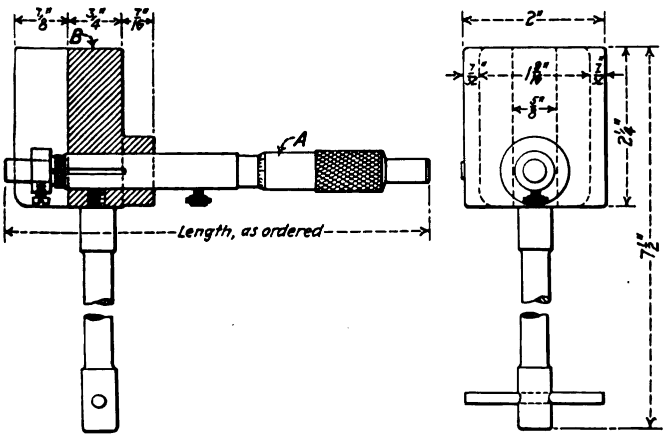


Fig. 3—Inside Micrometer Calipers with Special Attachments for Measuring Wheel Bores

Micrometer Calipers Eliminate Errors

In order to bring out the advantages of the outside micrometer and the inside caliper a brief description of the process of wheel boring will be given. Mention was made of marking the diameters of wheel seats on the axles. It is the practice in a number of shops to make a memorandum of the sizes marked on the axles. This memo is then handed to the car wheel boring mill operator who bores the wheels, starting at the top of the list and going down. Each wheel is bored a certain number of thousandths smaller than the sizes shown. The operator marks the finished diameter on each wheel, after which the wheels and axles are paired and mounted. The practice when boring is generally for the operator to measure the size of the bore of the wheel with the inside micrometers and make a note of the micrometer dial on the boring bar. The reading of the micrometer and the boring bar dial rarely agree, but the operator notes the difference in the two readings and makes the proper allowances. That is, if the measurement of a trial wheel bore is 6.650 in. and the bar dial .075 in. the operator understands that the dial should be set .025 in. high in order to obtain the correct size. (The bar dials generally only read to .1 in.) After ascertaining the correction to be made, it is only necessary to turn the dial to the required size previous to boring the wheel. After completing the finishing cut, the wheel bore is measured with the inside micrometers, this, in every day practice, being the only measurement made of the wheel bore. The measurement of the wheel is a continuous check for the correctness of the boring bar dial and the wear of the cutters. If the readings are low, showing wear of cutters, a greater allowance is made for the bar dial, which in place of .025 in., as mentioned above, may be increased to .026 in., .027 in., etc. With the recently designed boring bars having one set of cutters for roughing and a second set for finishing, the wear on the finishing cutters is slow and readjustment of allowances are not frequent.

If the size is found to be what is desired, the diameter of the bore is marked on the wheel and the wheel is removed from the boring mill. Should there be an error, the wheel is rebored for an axle having a larger wheel seat. It is also customary to measure the bore from end to end in one out of every 100 wheels to detect possible errors that may be caused by a defective boring bar or boring mill. A boring mill operator who is accustomed to the work may readily bore 95 per cent of the wheels to the desired diameter at first trial.

These micrometers at times get out of adjustment and should be frequently checked to the master standards which are supplied by the manufacturers of these instruments.

The advantages of this method which have been made possible owing to the use of micrometer calipers and the modern boring bars are at once apparent. Compare it with the older plan of calipering each axle with machinists' calipers, then setting a second pair of inside calipers to the first set and making allowances for the amount the wheel seat should be larger than the bore and possibly making a number of trial bores to see if the cutters are set for the correct size. It is a case of exact methods with micrometers versus hit or miss methods with the machinist's calipers.

The following questions may be raised as to the effect of the use of micrometers in a car wheel and axle shop.

1.—Can the general run of men employed in the shops make the proper use of micrometers?

2.—Will the men exercise reasonable care in their use?

3.—What will be the effect on the men?

4.—What will be the effect on the output?

5.—What will be the effect on wheel mounting pressures?

6.—Will time required to measure be reduced?

7.—Will the costs of micrometers and the upkeep be excessive?

The questions, after carefully studying the problem, are readily answered.

Men using micrometers.—As a general proposition, the men who have been brought up in car wheel and axle shops do not understand their use. However, very few men will be found in any railroad shop who do not have the necessary intelligence to master micrometers in a few days. Generally

when teaching their use, it is advisable to explain their principles and then allow the men to measure several articles, allowing a reasonable amount of time for acquiring the necessary practice and for the newness to wear off. Where it is understood that they must be made use of, the men acquire the knack of measuring and reading sizes and soon become very quick and proficient.

Will the men exercise reasonable care in their use?—The answer is decidedly yes. Workmen when given good tools want to keep them in good order. As proof of this, it is well to note the care taken by the workmen of the machinist's calipers, steel rules and similar tools.

What will be the effect on the men?—Workmen in practically any shop wish to do their work right. A man turning axles or boring wheels is just as proud of doing his work up to the standards demanded for his particular line of work as the man who does the finest kind of work to the standards which may call for the greatest possible accuracy. Where limits are set in thousandths of an inch to govern the amount a wheel seat or a wheel bore may be tapered, the workman knows the amount of leeway he has to go on and works accordingly. When there is a dispute between the workmen and the party passing on the acceptance or rejection of a piece of work, the limits of diameter which are readily measured with micrometers practically settles the question, thus eliminating the personal equation and a lot of ill feeling. In actual practice it is generally found in a micrometer equipped shop that the workmen are very proud of work well done and will invite the inspector to measure their work with micrometer in order to show their superiority. This is a spirit the value of which would be hard to estimate.

What will be the effect on the output?—Turning repaired axles to the largest diameter to which they will true up, means cutting away the least possible amount of metal and consequently prolongs their useful life. This results in a saving when compared with the practice sometimes followed by turning to snap gages or step sizes. The turning of axles just sufficiently to true up without regard to sizes reduces the time of turning to the lowest limit. In the case of new axles, they are turned within a reasonable shop limit that can without detriment be .005 in. plus or minus the size called for on the drawings.

These methods take the responsibility of the fit of the wheel on the axle entirely away from the lathe hand and put it on the boring mill operator, which in the light of experience, is the proper thing to do. To turn an axle to a limit of .001 in. which is necessary in order properly to press it into previously bored wheels is a slow and more expensive operation. To bore a wheel to this limit with a modern boring bar does not take any longer than simply boring without respect to size. The practice is when boring, to set the micrometer dial of the boring bar about .040 in. small and rough bore, after which the dial is set to the size required for the finishing cut and finish bore. The required size of the wheel bore is thereby obtained to the limits of .001 in. in two passes of the boring bar, which are generally conceded as being essential in order to obtain a true hole. The boring bars have one set of roughing cutters at the lower end and a set of finishing cutters mounted higher up. With this combination the boring operation is practically continuous which reduces the time required.

Another point well worthy of careful consideration is the question of wheel mounting. The use of the micrometers insures the wheel seats being turned to practical limits from end to end. Likewise, the wheel bore will be practically of one size from end to end. When mounting, the wheels will have an equal bearing throughout their length which, as well understood, is a desirable and safe feature.

Wheel mounting pressure.—The use of micrometers makes it comparatively easy to bore the wheel a predetermined amount smaller than the wheel seat, the exact amount of difference between the two having a number of variables that can only be found from trial mounting and experience. However, the exact amount of this difference when once ascertained is followed until conditions of the wheels or the axles change. Cast iron wheels from different foundries differ in mounting pressures even when bored allowing the same difference in diameter between the axle and the wheel. As a general proposition it will be found that cast iron wheels having a seven-inch bore, when bored .015 in. smaller than the axle wheel seat, will mount about 60 tons, and a steel wheel of the same size of axle when bored .007 in. smaller than the axle will mount at about 80 tons. However, the conditions are governed by the make of wheels, kind of lubricant used on the axle when mounting, smoothness of turning and boring, etc.

Time required when taking measurements.—In answering this question it is well for the purpose of comparison to take into consideration the practice with machinist's calipers. The latter must, from necessity, be set for each individual wheel seat, afterwards an inside caliper is adjusted to the first pair at which time allowances are made for the amount the wheel seat is larger than the wheel bore. When boring, one or more trials are made before the cutters are set to the correct size. Where the wheels are first bored and the wheel seats afterwards turned to a suitable diameter for the wheel, the practice is reversed. Either practice makes it necessary for the workman to travel from the axle pile to the boring mill for each wheel passing through the shop which not only consumes the workman's time, but, in addition, reduces the output of the boring mill. With the use of micrometers, in the larger shops, all wheel seats are measured by one man who is assigned for that purpose who checks for the amount of irregularity or taper and also chalks the sizes of the wheel seats on the axles and in addition makes a memorandum of these sizes, which is handed to the boring mill operator who bores to the sizes indicated. Under this condition the boring mill operator need not leave his station or delay the output for the purpose of taking measurements and as a result the output per machine is increased.

In the smaller shops where an inspector is not warranted, the axles are turned and laid on the floor, the boring mill operator then measures the wheel seats of a number of axles one after the other and makes a memorandum, the only delay to the boring mill being the time the operator is away to make the measurements. In other words, the measurements are made all at one time in place of traveling from machine to axle for each wheel seat, which is required when using machinist's calipers.

Is the cost of micrometer calipers excessive?—In a large wheel and axle shop, say where 15 axle lathes and four boring mills are employed, the following outside micrometers would be required:

No. of calipers required	Outside range From	To
1	4 in.	5 in.
2	5 in.	6 in.
2	6 in.	7 in.
1	7 in.	8 in.

The cost of the micrometer averages about $9. The attachments as shown in Fig. 1 will add approximately $15, or say $25 per micrometer, which makes $150 to equip the shop.

The following inside micrometers would be required:

No. of calipers required	Outside range From	To
1	4 in.	5 in.
4	5 in.	6 in.
1	6 in.	7 in.

The average cost of the bare micrometers is about $4.00 each, and the squaring block about $10, or for each caliper about $15. This makes about $90 to equip the shop. The above, with such master standards as should form a part of the equipment, will bring the total cost up to approximately $250 for a shop of this size. The cost of the equipment for a

shop employing six lathes and two boring mills would be about $150.

Experience has shown that the cost of upkeep of micrometers is low. They must be checked to master standards about twice a week owing to possible injury from falling or being accidentally hit. However, it is safe to assume that the cost of upkeep in a shop of this kind will not exceed $25 a year.

When considering the safety of the force fit of the wheel on the axle owing to the more uniform bore of the wheel and turning of the wheel seats, the time saved by the workmen when measuring wheels or axles and the general toning up of the shop, the use of micrometers becomes a paying proposition.

An an illustration of the possible speed when boring cast iron wheels such as used for new or repair work, in one shop where two of the most modern car wheel boring mills have been installed, which are equipped with adjustable boring bars having micrometer dials, separate roughing and finishing cutters and a radius tool for forming the fillet, these two mills are operated by one man who bores the wheels to sizes shown on memorandums within a limit of .001 in., places the wheels in and removes them from the mill at the rate of 10 per hour. This high output is made possible largely owing to reducing the calipering time. The machine work is not delayed in the least for the purpose of making measurements.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Bill for Repairs Should Agree with the Defect Card

On June 14, 1920, the Atlantic Coast Line repaired the Atlanta, Birmingham & Atlantic car No. 25075 at its Florence, S. C., shops. A joint evidence certificate was furnished by the owners which showed that two wooden draft timbers were used instead of Bradford metal arms and Miner draft rigging was used instead of Bradford draft rigging. On December 11, 1920, the Atlantic Coast Line issued a defect card for these two items and marked the defect card "Labor only," in accordance with Rule 88. The Atlanta, Birmingham & Atlantic did not object to this card but rendered its bill amounting to $31.21 to cover the repairs. The repairing line found an error in this bill that amounted to more than 10 per cent of its total and it was therefore returned to the owners on February 10, 1921, for correction. The owner instead of making the correction, issued a counterbilling authority which covered the entire charge against this car and rendered a subsequent bill amounting to $192.30, for both labor and material. The Atlantic Coast Line returned this bill stating that the defect card did not cover anything but the labor. The owner, however, claimed to have a recent interpretation which showed this charge to be correct and it quoted the following abstract from a letter from the Secretary of the Arbitration Committee dated January 31, 1921, which read as follows: "Rule 95 contemplates that missing friction draft gear shall be replaced by the repairing company for a charge for labor only, and rule 88 contemplates that the owner is entitled, on presentation of joint evidence, to defect card for a wrong draft gear applied on the authority of which it may make charge for correction." It was claimed by the repairing line that the Bradford draft gear is not a friction draft gear and therefore, this opinion had no bearing in this case.

The Arbitration Committee rendered the following decision: "Under Rule 88, 1919 Code, the Atlantic Coast Line defect card for labor only for correcting the wrong draft gear arms, is all that can be asked of the Atlantic Coast Line for this item.

"The Atlantic Coast Line billing repair card shows that the coupler, draft gear and yoke were missing and, according to Rule 95, these parts, when missing complete, must be assumed to be in good order. The Atlantic Coast Line defect card should, therefore, be issued for the material of draft gear and yoke and the labor of riveting the yoke, if necessary."—*Case No. 1295, Atlanta, Birmingham & Atlantic vs. Atlantic Coast Line.*

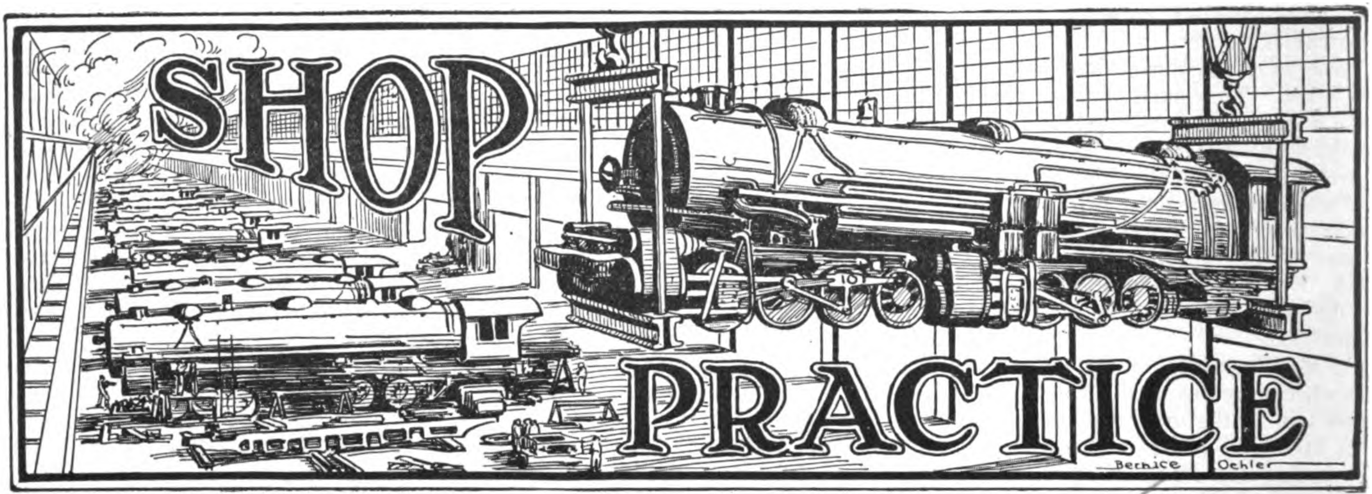
Car Burned While in Interchange

The New York Central box car No. 161091, loaded with charcoal, was placed by the Louisville & Nashville on the interchange track at East Birmingham, Ala., at 12:30 p. m., April 17, 1920, for delivery to the Southern Railway. The car was inspected by an inspector, who is employed jointly at that point by both the Southern and the Louisville & Nashville. It was found to be in good condition for acceptance in interchange, however, no billing accompanied the car and therefore, it was tagged to be returned to the Louisville & Nashville for proper billing. About 4:00 a. m., April 18, 1920, this car was discovered to be on fire by a passing train crew. The city fire department was called but before the fire could be extinguished the car and contents had been considerably damaged. The contents were salvaged by an agent of the Southern, after which the car was switched back and forth between the Southern and the Louisville & Nashville, neither of whom would acknowledge possession. The car remained on the Southern shop yards while the matter was being handled by representatives of the Insurance and Transportation Departments of both roads to settle the question of possession and also to place the responsibility. Repairs were finally made by the Southern at a cost of $683.08. Efforts were made by that company to have the Louisville & Nashville assume all responsibility for the damage from the fire. It contended that the car was not in its possession within the meaning of rule 6 of the Car Service Code and also this rule had not been complied with, which requires that the billing precede or accompany the car when it is being moved from the interchange tracks. The Louisville & Nashville claimed that Rule 6, of the Car Service Code, should not decide which line had possession of the car. And as the car had been duly inspected and accepted by the Southern Railway inspector under the A. R. A. Rules of Interchange it was contended that the car was in the possession of the Southern at the time of its destruction.

The Arbitration Committee made the following decision: "The Southern Railway is responsible for the damage to this car. Decision 1254* applies."—*Case No. 1296, Southern Railway vs. Louisville & Nashville.*

*Case No. 1254 was abstracted in the August 1923 number of the *Railway Mechanical Engineer.*

BULLETIN No. 7 has been issued by the Railway and Locomotive Historical Society, 6 Orkney Road, Brookline, Mass. This number consists of about 75 pages and is full of interesting matter. The longest article is on early locomotive building in Lowell, Mass., a paper read by Edwin R. Clark before the Lowell Historical Society. This paper summarizes a large amount of research, the author having gone through the records from the beginning of the nineteenth century. He gives interesting notes concerning George Brownell, Nathan Appleton, Zerah Colburn, Walter McQueen and Wilson Eddy. Other papers deal with the locomotive history of the South Carolina Canal & Railroad Company, the Louisville & Nashville and the Central Pacific.



Some Questions in Modern Shop Design

Flexibility of Arrangement with a View to Probable Future Expansion Is an Important Consideration

By E. Wanamaker
Electrical Engineer, Chicago, Rock Island and Pacific, Chicago

APPARENTLY the trend of today in railroad shop design is along such lines as will assure both better work and greater shop efficiency. At the same time we must not lose sight of the fact that it is necessary to keep the shop fixed charges as low as possible. It is therefore highly important that the first cost of land, buildings and machinery be held as low as compatible without lowering the shop efficiency or affecting the quality of the output. Therefore, we are as a rule led to the establishment of one or more main shops and in the case of large railroads, as many smaller shops as may be necessary economically to expedite locomotive maintenance and repairs.

Good business demands that shops and engine houses should be so designed today as to be economically serviceable 30 years hence, and should also be designed in such a manner as to permit an increase in capacity from time to time without lessening or decreasing the net efficiency. The locomotives to be repaired in the future may be steam, electric or internal combustion engine drive, or any combination of these types, and again each of these classes may have various sub-divisions of types or classes. This fact should be borne in mind when the design of new shops and engine houses is under consideration.

To accomplish the desired results, a system design as a whole should be worked out and a program adopted such as will guarantee constantly increasing efficiency and economy during the succeeding years, rather than decreased efficiency and economy.

Shop Location

With due consideration being given to the economic location as regards distribution of power, labor market, cost of real estate, etc., it may be found that on a small road one main shop and several modern engine houses will be sufficient to meet all requirements, while larger roads may require one main shop and several small shops, while still larger roads may require two or more main shops and several small shops.

It goes without saying that time and labor saving devices are a necessity today in both shop and engine houses, but sad to relate, few railroad mechanical departments have been able to secure sufficient modern facilities. Then, too, it must be borne in mind that modern ability and skill are necessary in both officers and men if efficient use, with resultant economy, is to be obtained from such modern facilities. Briefly, modern skill and ability are as necessary today as modern facilities, to economically maintain the steadily increasing technical complications in the modern locomotive equipment, together with the steadily increasing technically complicated machinery for maintaining such locomotives. Indeed, it seems even more difficult to obtain modern men than to obtain modern facilities.

Comparing the cost of motive power with the cost of modern shops and engine houses, it seems that we are not justified in operating shops and engine houses that are not at least being gradually modernized by following a well-planned program. A shop having a capacity of say 12 or 15 locomotives a month can as well be modern as a shop having a capacity of 25 or 50 locomotives a month. As a matter of fact, the cost of supervision is probably lower, and the efficiency of the workmen better in a small shop than in a large one. As a rule, however, the heavy back end or firebox work is best confined to a main shop and, preferably, to a large main shop.

Layout of the Main Shop

It is felt by many that large railroads should have at least one locomotive production shop—that is, a shop doing no shop order or manufacturing work—such work to be performed preferably in a shop devoted to manufacturing only, or perhaps making repairs to work and maintenance of way equipment as well. The rest of the shops might well and economically handle some such work along with their regular locomotive work. A careful study is necessary to decide this problem.

There are several general plans or designs which must be considered before any of the detail designs can be given consideration.

First—Shall the shop be under one roof, or shall it be divided into several buildings?

Second—Shall the locomotives for repair be placed longitudinally in the erecting shop, transversely, or on an angle?

Third—Shall cranes or hoists be used for wheeling and unwheeling locomotives?

In this connection, it must be decided whether a locomotive is to be moved progressively through the shop, or whether it is to be unwheeled, repaired, wheeled and finished on one pit or blocking location. The stripping and finishing pits may or may not be the same, depending on the general design of the shop. For a shop having a capacity of 25 locomotives or more a month, there is much to be said for a design embodying the use of cranes for handling the locomotives. For a shop with a capacity of 12 or 15 locomotives per month, there is much to be said in favor of locomotive hoists, and the use of a transfer table.

Just here it might be well to say that a locomotive shop or enginehouse should be laid out with respect to the work to be done and the building then formed around the shop itself, considering that the building is not the shop but only an envelope covering the shop. This is especially true when we pause to consider that the shop or enginehouse should be one that can be economically used 25 or 30 years hence.

When locomotives were small and the Stevenson valve motion was standard, it was necessary to have a pit under each locomotive. Today with our large modern power with outside valve gear it would seem that the necessity for pits has disappeared, except for stripping, wheeling or finishing locomotives. This will apparently hold true for any shop where the stripping and finishing is done on separate pits from the blocking locations.

Description of Proposed Shop Layout

The following is a brief description of a proposed shop having a capacity of 15 locomotives a month of average size, with probably 12 locomotives capacity a month for larger power, the only pits to be those constructed for stripping and finishing or wheeling, located in the same end of the erecting shop. The remaining portion of the erecting shop is to be used for engine blocking locations, preferably arranged in a longitudinal manner, with the engines so blocked that they can be set close together, end to end, at a sufficient angle from the longitudinal shop center line to permit easy flue replacements. The relative capacity and exact location of stripping and erecting pits to each other, and to the blocking locations, depends upon the final conclusion reached after detailed study.

It would seem that the greatest flexibility and capacity can be thus secured, especially so when various classes and sizes are to be shopped simultaneously, as this will enable the utilization of space to the fullest capacity and greatest advantage from both efficiency and production standpoints. Such an arrangement will in all probability enable the shop to handle successfully any size or type of motive power that may be developed within the next 30 years.

Locomotives should be blocked sufficiently high to eliminate the necessity for pits. Suitable floor drains and traps should be provided for draining boilers on test, etc. In this way the erecting floor space can be kept filled, regardless of classes of locomotives on the locations, which is not true where the herringbone arrangement of pits or transverse pits is used. Two cranes in the erecting shop bay can easily handle all locomotives and at the same time with auxiliary hoists sufficiently serve all operations for which cranes are desirable.

It will be here noted that this particular proposal includes cranes for handling the locomotives in the erecting shop and is therefore called a crane erecting shop design. It should be borne in mind too that a well designed shop using locomotive hoists and pitless blocking spaces might prove a still better design for the small shop. In such a case pits or blocking spaces or locations should be equipped with track rail so that shop trucks may be used for moving locomotives to and from hoists and pits or blocking locations. A transfer table and transverse locations or pits then become desirable if not necessary. It is felt by many, however, that the large shop—25 to 50 or more locomotives capacity—could only be well designed by making use of locomotive handling cranes for the erecting shop.

In our proposed shop the heavy machine shop tools, wheel lathes, etc., can be so located in the machine bay alongside the pit end of the shop as to necessitate a minimum movement or transfer of heavy parts to be machined.

In the boiler and tank shop bay, the heavy boiler work can be handled with greatest efficiency by locating such work opposite the pits, leaving all of the lighter boiler work and flue shop work for the middle section of the bay, with the tank and cab work for the far end of the boiler and tank shop bay, with service tracks entering doors at that point. By such an arrangement, ample space and service can be provided for trucks, stokers, boosters, feed water heaters, pumps, etc., that may be a part of the locomotive.

The general design calls for practically three shop divisions—a center bay erecting shop, one side bay for the boiler and tank shop and the other side bay, for the machine shop. It might be advantageous to install a comparatively narrow gallery or mezzanine floor next to the outer wall of the machine bay, for handling all of the light locomotive equipment, such as lubricators, injectors, electrical equipment, gages, etc.

If available funds are short, cranes in the boiler and tank shop and in the machine bay, could be installed at a later date than the initial installation; in such case it would be necessary to have an inexpensive elevator for handling the light material to or from the gallery or mezzanine floor. The shop supervisor or foreman's office, might well be located on such a gallery.

This type of shop seems to lend itself to an extension or increase in capacity at any time without decrease in shop efficiency or increase in shop unit construction cost. Detailed study will probably suggest that either one or both end walls of the shop should be of a comparatively temporary nature, so that they can easily be moved in case of shop extension. The type of building necessary to house such plant will in all probability be lower in cost than any other type for a modern shop, considering the cost of a transfer table of ample capacity, in case a transverse pit shop is considered.

Provide Cleaning Facilities Outside of Shop

Study of the possible methods of cleaning locomotives before entering the shop, indicates that the sand blast method used on the outside of the shops or possibly located in a shed built adjacent to the locomotive entrance doors of the shop and over the incoming tracks, will prove the most economical and at the same time the most desirable. That part of the incoming track on which the locomotives are to be cleaned, should have a concreted basin underneath, to catch all of the sand and drain it into a receptacle or receiver from which it can be moved by air pressure to be again used in the sanding nozzle, thus using the sand over and over until such time as it loses its sharpness, when the sanding equipment can be recharged with new sand. It seems that if such a cleaning arrangement is properly installed and handled, the locomotive will go into the shop thoroughly cleaned, making it easy to locate possible fractures, etc., at the same time making it much more pleasant for those who handle the various parts, as well as increasing the speed at which they will handle them. At present it seems that a close check will in all probability indicate this

to be more efficient and more economical than the lye vat process or any other available method of cleaning.

Arrangement and Equipment of Pits Important

In considering the design for stripping and finishing pits in the shop, it would be well to consider having the rails supported on pedestals with a complete open pit underneath and with manways and steps conveniently located for entering or leaving pit, and some form of removable floor boards for roofing over the pits at such times as openings through the floor are not necessary or desirable.

The electric light and power receptacles should be conveniently located under the pits for plugging in portable electric lights and motor-driven portable machinery. Permanent lights should be installed in recesses in and under the pit with reflector used to project the light where needed.

One advantage of the pitless arrangement of the erecting shop lies in the ease with which it is possible to thoroughly clean the shop floor each night, washing down with a hose if deemed desirable.

The longitudinal aisle between the blocking locations should be such that locomotives can be moved up and down the shop without having to carry them over those on blocking locations, and sufficient room should be left around the locomotives for placing the parts for re-assembling. There should be sufficient room left throughout the entire shop for operation of power-driven trucks for handling material.

It would seem that a shop embodying these principles of design can be used for shopping miscellaneous forms of power such as are in use at the present time, and in fact could be made to successfully handle internal combustion motor cars and locomotives and electric locomotives, as well as the various types of steam locomotives that may be used.

Should such a shop as this have its capacity increased to say 40 or 45 locomotives a month, due to increase in business in that particular shop territory, it might be possible to increase the shop capacity by way of double ending, that is, working locomotives in and out from each end, or doubling equipment at each end, with some changes in the equipment in the intermediate section of the shop. It is realized, of course, that for electric locomotives or internal combustion locomotives, it would be necessary to change the machine tool arrangement, but in no way would it be necessary to change the general arrangement of the shop and buildings.

It is probable that the chief advantage in a pitless shop at the present time lies in the better utilization of small space and volumetric dimensions combined with the flexibility of the shop as regards capacity and future requirements.

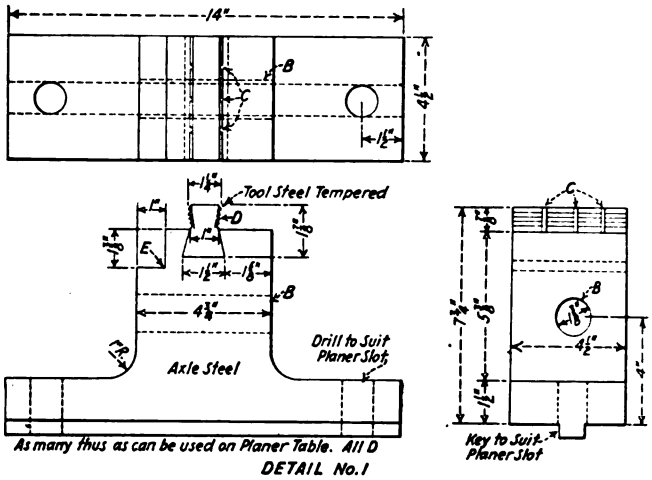
Driving Box Shoe Planing Device

By J. D. Snyder

A DEVICE for semi-finishing driving box shoes or both shoes and wedges, for placing in stock, is shown in the illustrations. By means of this jig the shoes are planed on all surfaces except the box face at one set up. This side is left unfinished until ready to be used for repair work.

The device consists of a number of fixtures as shown in detail No. 1. It is made of steel or wrought iron, drilled for tee head bolts to suit the slot in the planer table and is also drilled at *B* to receive the tie rod *F*. A tongue is also required on the bottom to suit the slot in the planer table. The tee head bolts and tongue should be a sliding fit in the slot to permit longitudinal motion when the bolts are loosened. At the top of the fixture a piece of tempered and roughed tool steel *D* is dovetailed in. The slots *C* are for the purpose of preventing lateral motion of the shoes. At *E* a step or off-set is cut out for use when both shoes and wedges are planed. The wedge-bolt end of the casting is placed on the step as shown in Fig. 2. Liners may be placed under the ends to secure the proper taper. The fixtures should be placed on the table in such a position that the tool will start cutting at the wedge bolt end of the casting.

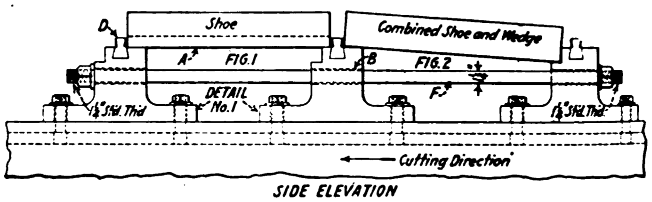
After mounting as many fixtures on the planer table as possible, a steel tie rod *F*, shown in the side elevation, 1¼



Fixture for Holding Driving Box Shoes Rigidly on Planer Table

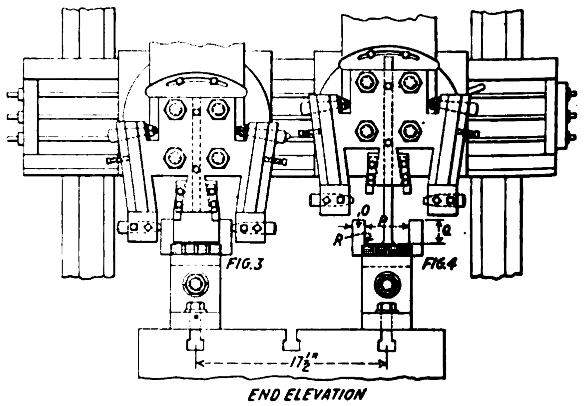
in. in diameter and threaded at each end, is run through the hole *B*. This will tie together all the fixtures on the table bed. The shoes are then placed in the fixtures and held rigidly in place by drawing up the nuts on either end of the tie rod.

The tool holder consists of the body shown in detail No. 7,



Method of Fastening Fixtures on Table and Holding Shoes Firmly in Them

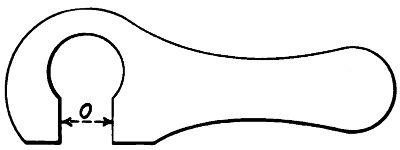
having two slots machined in it at *X* to receive the tools X^1 (see the plan view), which are of ⅞-in. square material. They machine the inner sides of the shoe. The long slot *Y* receives tool Y^1 which is of ¾-in. by 1½-in. material. The



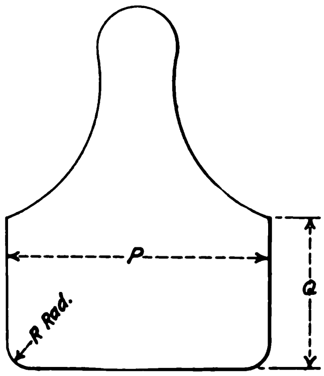
General Arrangement of Tools and Fixtures on Planer

tool machines the inside bottom surface of the shoes. The two slots at *Z* receive detail No. 8 which is the holder for tools W^1 which are of 1 in. sq. material. These tools machine the outer sides of shoes. These holders are placed

at an angle of eight degrees so that they will swing away from the shoes when the planer reverses. The tool holder detail No. 8 is drilled and tapped at 3^1 for a screw, detail No. 3, which holds the tool W^1 in a slot W. It is also drilled and reamed at 4^{11}, and detail No. 7 at 4^1 for the taper bolt,



DETAIL No. 9 1/16" Thick



DETAIL No. 10 1/16" Thick

Gauges for Determining Thickness and Contour of Shoes

detail No. 4. This bolt is tapered to permit taking up the wear which assists in preventing chatter.

Detail No. 7 is drilled at 5^1 for a set screw, detail No. 5, which keeps detail No. 8 a snug fit and also assists in preventing chatter. It is also drilled and tapped for a set screw, detail No. 6, which is used to hold the tools X^1; for another, detail No. 2, to hold tool Y^1. It is drilled at V for a stud which holds it to the planer apron block.

The tool holder is mounted on a regular planer apron block. Tools W^1 and X^1 are inserted the proper distances apart. Tools X^1 are inserted in such a position that when tools W^1 are at the bottom of the outer sides of the shoe tools X^1 will be at the bottom of the inner sides. The tool holder is then raised high enough for the ends of detail No. 8 to clear the top of the shoes. Tool Y^1 is then inserted in slot Y and the inner bottom of the shoe is finished.

The tool holder shown can be used for shoes for all locomotives except the heaviest types. For the heavier types use the chart showing dimensions A, B, C, and D.

A caliper gage as shown in detail No. 9 is used for gaging the thickness of the sides of the shoes. Detail No. 10 shows a gage used for the inside contour. The dimensions P, Q

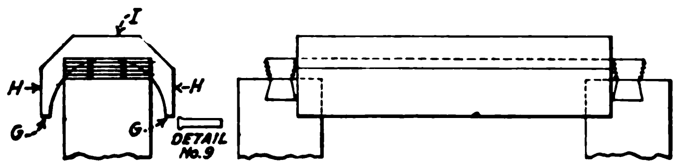
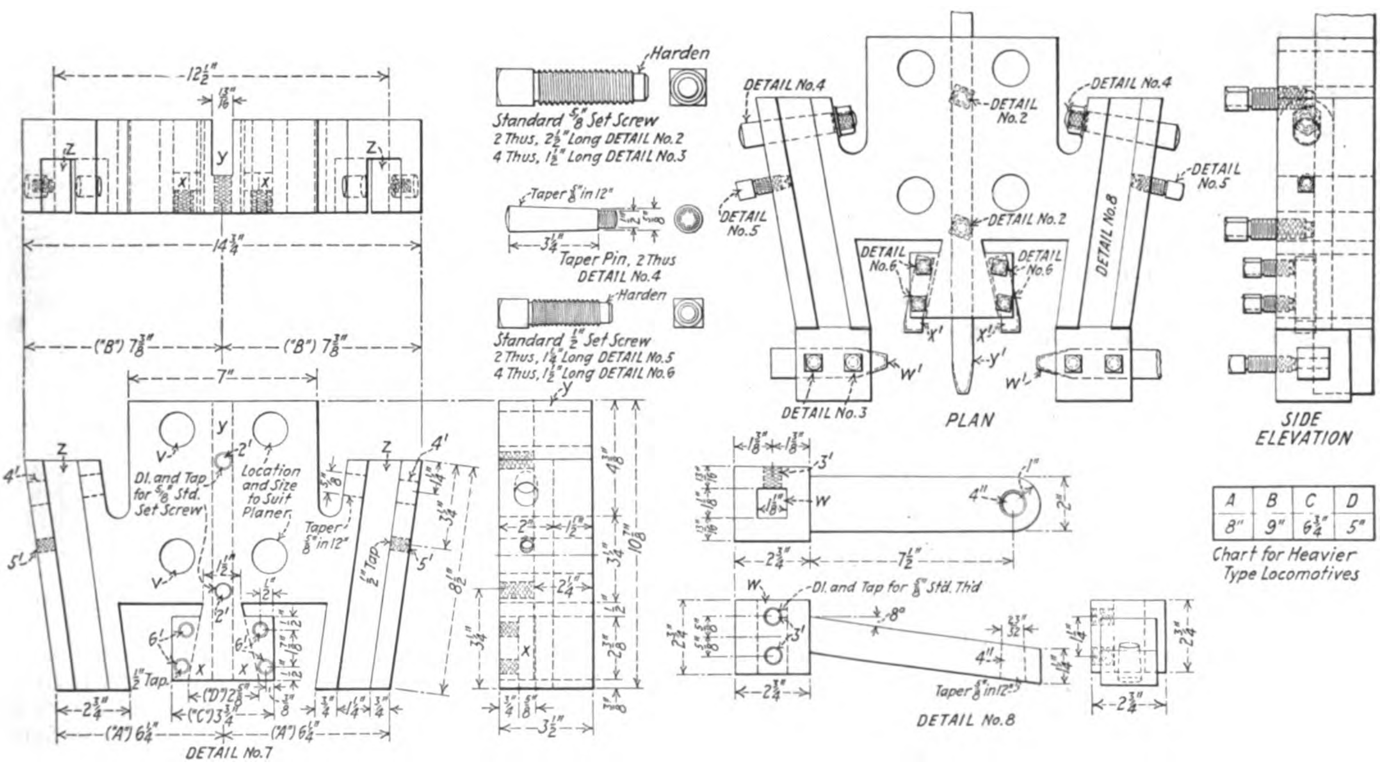


FIG. 5

Fixture for Machining Engine and Trailer Truck Box Shells

and R on the gage correspond to the same dimension shown on the shoe in Fig. 4.

While originally designed to facilitate the planing of driving box shoes, these fixtures and tools can also be used to good advantage in machining engine and trailer truck box shells. For this work the rough castings are placed in the fixtures as shown in Fig. 5 and tightened the same as the driving box shoes. The tools X^1, which machine the inner sides of the shoes are removed and the tool Y^1 which machines the bottom of the shoes is used to finish the surface I. The tools W^1 which machine the outer sides of the shoes are set the proper distance apart to machine surfaces H^1.



A	B	C	D
8"	9"	6 3/4"	5"

Chart for Heavier Type Locomotives

Tool Arrangements for Planing Driving Box Shoes on All Sides Except the Box Side with One Set Up

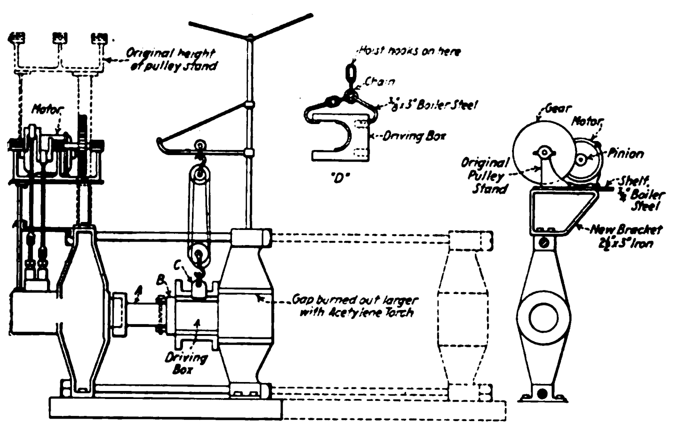
The swinging tool block is then raised and secured in this position by filling in behind it. The tool holders, detail No. 8, are also fastened rigid by set screws, detail No. 5, and the tools shown in detail No. 9, are inserted to machine the surface G, by moving the planer heads on the cross rail.

Truck Wheel Press Converted Into a Driving Box Press

By V. T. Kropidlowski

WHEN a new 400-ton hydraulic truck wheel press replaced an old 150-ton press, it was decided to recondition the old machine for use in a small engine terminal shop as a driving box and rod brass press. To save floor space, it was reduced from the length shown by the dotted lines in the sketch to a length more suitable for the smaller work. The same end resistance post used on the truck wheel press was utilized on the new machine on account of the fact that the center post was a hinged post and could not be bolted to the bed plate.

By referring to the sketch, it will be noted that the hydraulic pumps were originally belt driven and that this feature was changed to a motor drive. The pillar that supported the pulley stand was too high to serve conveniently as a motor support, so it was discarded and a shelf substituted, as shown in the sketch. The same pulley stand and crank shaft was utilized, but the pulleys were removed and a gear was applied in their place. The lowering of the crank shaft necessitated the shortening of the connecting rods to 30 in. The pumps were worn to such an extent that they had to be rebored and new plungers made. The original plungers, of



Sketch Showing the Original Press and the Amount It Was Reduced in Order to Handle Driving Boxes

which there are two, were $\frac{3}{4}$ in. and 1 in. in diameter, respectively, but the new ones were made 1 in. and $1\frac{1}{4}$ in. diameter. The change in the plunger diameter provided sufficient pressure for driving box work.

A 5-hp., 3-phase, squirrel cage induction motor, controlled by a 3-ampere, 440-volt General Electric starting switch, furnishes power for the machine. The gearing consists of a rawhide pinion, $3\frac{4}{5}$ in. pitch diameter, $2\frac{1}{4}$ in. face with 19 teeth, and a large gear with $20\frac{2}{5}$ in. pitch diameter, 2 in. face, with 102 teeth. The motor, when loaded, runs at 1,160 r.p.m. The speed of the crank shaft is 216 r.p.m. This may appear to be fast for a pump to run, but from the experience in this shop, it has proved to be quite satisfactory. The ram is $8\frac{1}{2}$ in. in diameter. Considering the gearing ratios and the area of the pump plungers to the ram, it is calculated that the ram will travel 22 in. per minute. Accordingly, the power developed by the ram when pressing in brasses at 35 tons will be 130,000 ft. lb., or approximately four horsepower.

According to these figures, the reader will doubtless consider a 5-hp. motor as too small on account of the fact that the overall efficiency would have to be 80 per cent, which is impossible. The efficiency of the motor alone is not much more than 80 per cent. But when it is considered that the load is of only short duration, and the motor a 40-deg. motor, it can stand to be overloaded for short periods as much as 200 per cent. In this case, then, the overall efficiency can be as low as 40 per cent.

Some of the details are shown in the sketch that have been added to facilitate the handling of driving box brasses. Shoe *A* is made to fit the ram and is reduced in diameter toward the driving box end in order to accommodate the smallest driving box. Several sizes of the tip *B* are made to go over the small end of the shoe *A* so as to fit the different sizes of driving box brasses. A post crane is provided from which a $\frac{1}{2}$-ton differential chain block is suspended for handling the boxes and rods. The hooks *C* are used for grabbing the box, as shown in the sketch at *D*.

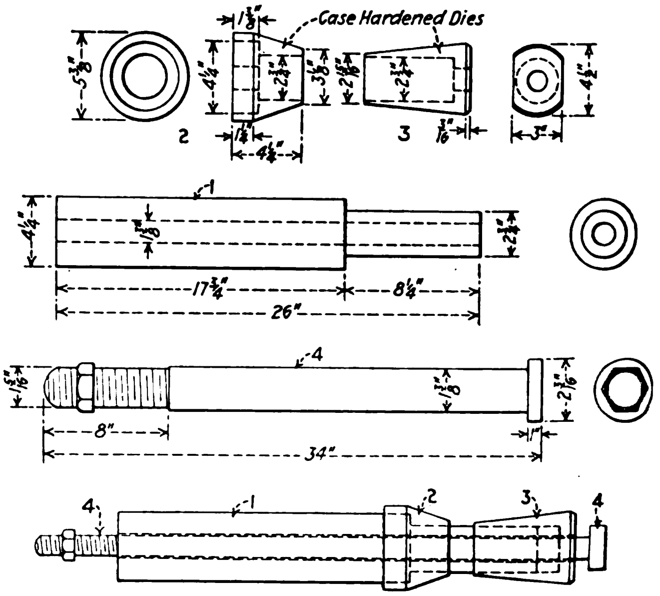
The work of shortening the press was performed with an acetylene torch. The total cost of reconditioning, including the electric drive, was $284.90.

An Adjustable Crosshead Mandrel

By H. H. Henson
Southern Railway, Chattanooga, Tenn.

A MANDREL used to set up crossheads on a planer is shown in the drawing. This tool should be permanently fixed in V-blocks on the back end of a planer so that it is always ready to take care of any emergency work that may be necessary for the enginehouse.

The device consists of four parts, namely, the mandrel, two cones, and the tightening-up bolt. The mandrel and two cones are made from a good quality of steel and case-hardened. The cones are tapered to fit into the taper in the



A Mandrel for Quickly Setting Up Crossheads on a Planer

crosshead, enabling the operator to quickly draw it up to working position. As piston tapers vary considerably, it is advisable to have two or three sizes of these cones on hand to take care of any crosshead that may have to be finished.

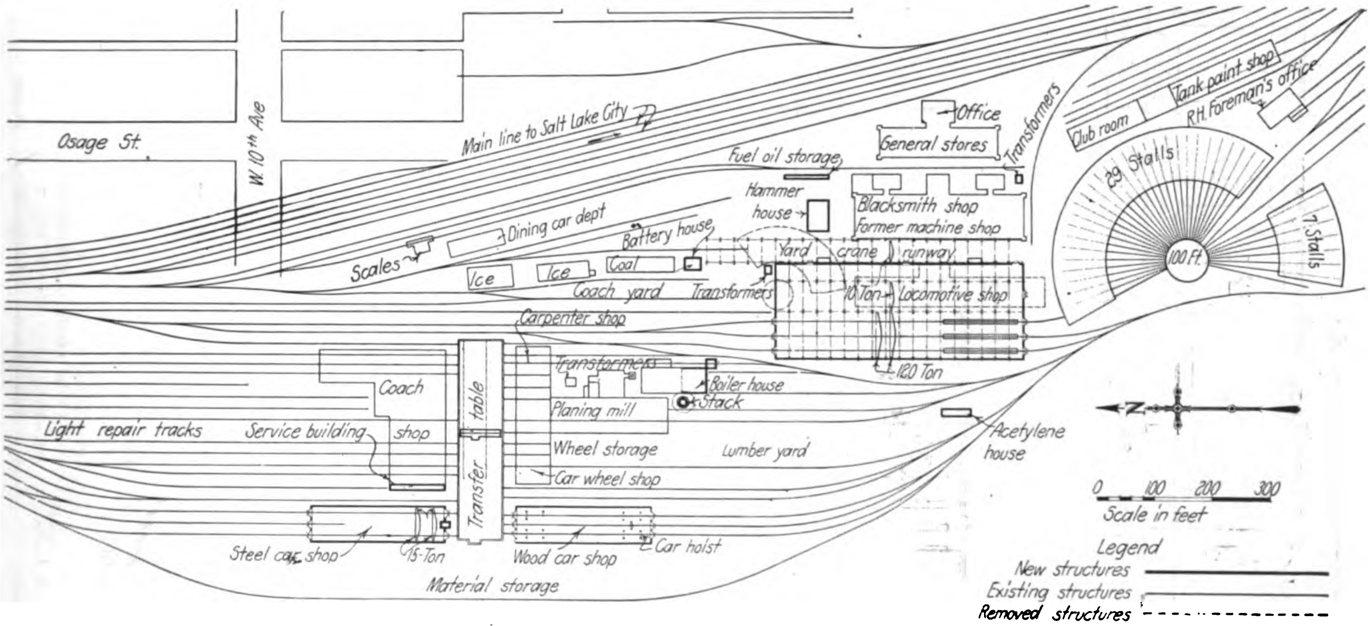
It is very easy to set up the crosshead for planing. Referring to the drawing, first detach rod *4* and cone *3*. Place the crosshead on cone *2* and then put rod *4* through mandrel *1* and tighten the nut on the rod. This squares up the crosshead and insures an accurate job. By the use of this mandrel, the average time to plane a crosshead complete is about 30 min.

The Heavy Machine Bay in the Denver Locomotive Shop, Showing the Wheel Department

Locomotive Shops Reconstructed on D. & R. G. W.

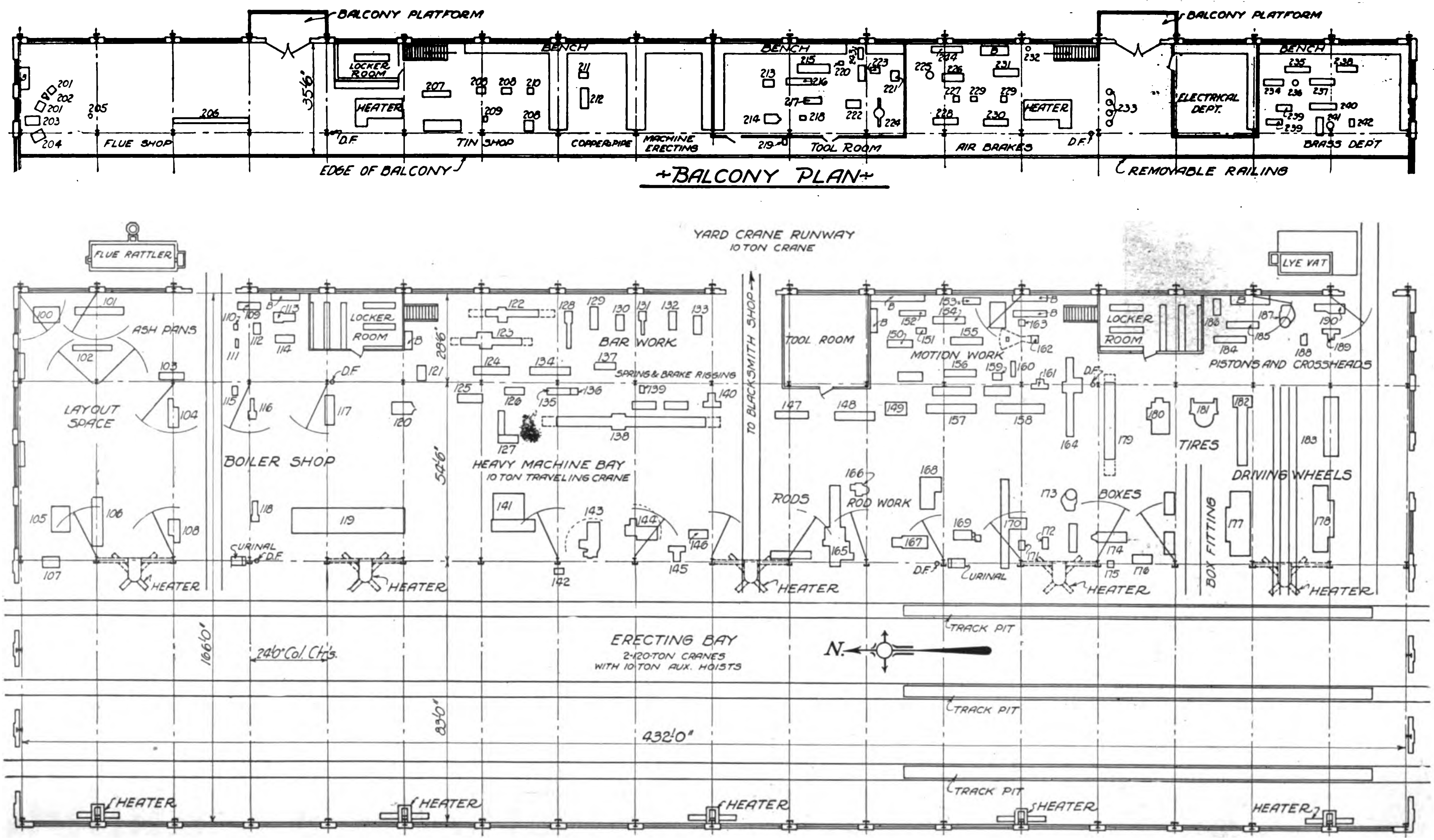
Program Includes Additions to the General Repair Plants at Denver and Salt Lake City

THE construction program undertaken by the Denver & Rio Grande Western late in 1923, which involved an expenditure of nearly $3,000,000, is now nearing completion. This program was the result of a survey which was made in order to solve the problem of maintaining a proper balance between the constantly increasing size and number of locomotives and cars, and the facilities for maintaining and handling this equipment. In this survey consideration was given to all of the elements affecting the maintenance of equipment and the care of locomotives at terminals to determine the necessity for additions to existing facilities, with the purpose of counteracting the increased cost of maintenance due to high wages, more intricately designed locomotives and heavier units in both locomotives and cars, as well as to decrease the delayed time used in holding equipment under repairs. This investigation included many important items, such as the distribution of equipment, the source of supply of materials, the labor market, the continuation of existing facilities, and the probable future traffic developments.



The Layout of the Denver Shop Track and Buildings

Increased labor rates and correspondingly increased costs of freight car maintenance, which has brought the total sum now being expended for the repair of freight cars up to and sometimes in excess of the cost of maintenance of locomotives, have made it of vital importance that facilities be provided to assist in reducing this cost. Particular attention has been given to this subject on the Denver & Rio Grande Western with the result that identical freight car repair shops have been built at Denver and Salt Lake City, in which production methods are being applied to repairs to freight cars with very satisfactory results. At Salida and Grand Junction old locomotive repair shops, vacated through the provision of new buildings for locomotive repairs, have been made available for housing the heavy repair



Floor and Balcony Plan of the Machine and Erecting Shop at Denver

100—Hand rolls—D. & R. G. W.
101—Flanging clamp—D. & R. G. W.
102—36 in. double end punch and shear—Williams-White.
103—Face plate—D. & R. G. W.
104—Single end punch and shear—Hilles & Jones.
105—Face plate—D. & R. G. W.
106—Flanging clamp—D. & R. G. W.
107—Flanging fire—D. & R. G. W.
108—Single end punch and shear—Hilles & Jones.
109—20 in. x 7 ft. 6 in. engine lathe—Pond.
110—12 in. sensitive drill—Rockford.
111—Hack saw—Marvel No. 2.
112—Bolt squaring machine—W. G. Young.
113—1½ in. double bolt threader—Acme.
114—1½ in. double bolt threader—Acme.
115—3 in. x 16 in. double grinder—Blount.
116—Single end punch—Cleveland.
117—48 in. rotary shear—The Quickwork Co.
118—Flange punch—Rock River.
119—Bending roll—Wicks.
120—5-ft. radial drill—Wm. H. Warren.
121—2 in. triple head bolt cutter—Landis.
122—32 in. x 32 in. x 14 ft. planer—Niles.
123—36 in. x 36 in. x 14 ft. planer—Sellers.
124—30 in. x 13 ft. engine lathe—Putnam.
125—20 in. single head slotter—Niles.
126—36 in. single head shaper—Bement Niles.

127—Cold saw—Q. M. S.
128—7½ in. x 28 in. turret lathe—Gisholt.
129—3 in. x 36 in. turret lathe—Jones & Lamson.
130—3 in. x 36 in. turret lathe—Jones & Lamson.
131—5 in. x 24 in. turret lathe—Gisholt.
132—2 in. x 24 in. turret lathe—Jones & Lamson.
133—2 in. x 24 in. turret lathe—Jones & Lamson.
134—30 in. x 13 ft. engine lathe—Putnam.
135—Nut facer—Putnam.
136—Centering machine—Whiton.
137—16 in. single head slotter—Betts.
138—60 in. x 60 in. x 27 ft. planer—Pond.
139—1½ in. x 12 in. double grinder—D. & R. G. W.
140—24 in. upright drill—Colburn.
141—60 in. cylinder planer—Morton.
142—3 in. x 16 in. double grinder—Blount.
143—6 ft. radial grinder—American Tool.
144—6 ft. radial grinder—Niles.
145—24 in. upright grinder—Colburn.
146—50-ton vertical hydraulic press—D. & R. G. W.
147—24 in. x 12 ft. engine lathe.
148—Horizontal borer—Niles.
149—2⅜ in. x 18 in. internal grinder—Heald.
150—18 in. x 8 ft. engine lathe—New Haven.
151—16 in. x 16 in. x 46 in. planer—Miles.
152—24 in. x 9 ft. engine lathe.
153—16 in. x 6 ft. engine lathe—Putnam.
154—20 in. x 10 ft. engine lathe—Putnam.
155—20 in. x 10 ft. engine lathe—Putnam.
156—20 in. x 10 ft. engine lathe—Putnam.
157—42 in. x 16 ft. 6 in. engine lathe—Putnam.
158—36 in. x 14 ft. engine lathe—Wm. Bement & Son.
159—2 in. x 16 in. double grinder—D. & R. G. W.
160—12 in. x 50 in. grind stone—D. & R. G. W.
161—24 in. upright drill—Colburn.
162—Link grinder—Hemmet No. 2.
163—Screw press—D. & R. G. W.
164—42 in. x 42 in. x 16 ft. planer—Sellers.
165—48 in. x 42 in. x 14 ft. slab miller—Bement.
166—44 in. boring mill—Niles, Bement, Pond.
167—60 in. horizontal borer—Niles.
168—Adj. rotary miller—Ingersoll.
169—50 in. x 14 in. x 21 in. universal miller.
170—Guide bar grinder—Diamond.
171—3 in. x 16 in. double grinder—J. C. Blount.
172—4 in. pipe cutter—Oster.
173—42 in. vert. turret lathe—Bullard.
174—4-ft. radial drill—Dreses.
175—Pneumatic pipe bender—Underwood.
176—50-ton vert. hyd. press—D. & R. G. W.
177—79 in. driving wheel lathe—Niles.
178—90 in. driving wheel lathe—Putnam.
179—48 in. x 48 in. x 16 ft. planer—Putnam.
180—H. D. draw cut shaper—Morton.
181—84 in. vertical borer—Niles.
182—600-ton 84 in. wheel press—Chambersburg.
183—Quartering machine—Niles, Bement, Pond.
184—17 in. x 10 ft. engine lathe.
185—17 in. x 10 ft. engine lathe.
186—Keyway machine—Bement, Miles.
187—42 in. vert. turret lathe—Bullard.
188—4 in. x 36 in. single grinder—D. & R. G. W.
189—24 in. upright drill—Colburn.
190—42 in. turret lathe—Grant.
201—Two-flue fires—D. & R. G. W.
202—Flue horn—D. & R. G. W.
203—Flue welder—Hartz.
204—Flue swedger—D. & R. G. W.
205—Pivot—D. & R. G. W.
206—Flue cutter—D. & R. G. W.
207—Cornice brake—Peck, Stowe & Wilcox.
208—Three-squaring shears—Peck, Stowe & Wilcox.
209—Single end hand punch—D. & R. G. W.
210—Splitting shear—Badger.
211—2½ in. x 8 in. pipe cutter—Saunders.
212—⅛ in. x 2 in. pipe cutter—Saunders.
213—Universal miller.
214—Die singer—Pratt & Whitney.
215—18 in. x 10 ft. engine lathe—Lodge & Shipley.
216—20 in. x 10 ft. engine lathe.
217—16 in. x 6 ft. engine lathe—Putnam.
218—12 in. sensitive drill—Concver & Overcamp.
219—Hack saw—Thompson.
220—Twist drill grinder—Wilmarth and Morman.
221—Universal grinder—Landis Tool Co.
222—12 in. shaper—Bement.
223—Water tool grinder—Gisholt.
224—Surface grinder—Thompson.
225—Sensitive drill—D. & R. G. W.
226—18 in. shaper—Bement Miles.
227—Grinder—D. & R. G. W.
228—16 in. x 8 ft. engine lathe—Fitchburg.
229—Two 2 in. x 16 in. double grinders—D. & R. G. W.
230—16 in. x 8 ft. engine lathe—Fitchburg.
231—20 in. x 8 ft. engine lathe—Reed.
232—Air compressor—Westinghouse.
233—Pump racks—D. & R. G. W.
234—18 in. x 6 ft. brass lathe—American.
235—20 in. x 10 ft. engine lathe.
236—Valve grinder—Automatic.
237—18 in. x 6 ft. brass lathe—American.
238—20 in. x 8 ft. engine lathe—Putnam.
239—Two 14 in. x 5 ft. 6 in. brass lathe—American.
240—16 in. x 6 ft. brass lathe—Acme.
241—Air reservoir—D. & R. G. W.
242—1½ in. x 12 in. double grinder—D. & R. G. W.
243—Dumb waiter—Kimball.
244—Triple valve test rack—Westinghouse.

freight cars originating at these intermediate terminals, not scheduled for repairs at the main repair plants.

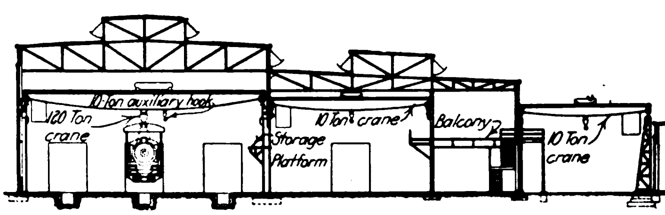
The New Locomotive Shop at Denver

The Denver, Col., terminal is located at Burnham, just inside the southern limits of the city. The new development consists essentially in the provision of a large, modern locomotive erecting and machine shop; a steel car shop and a wood car shop. An extension of the existing boiler plant and the addition of oil storage, electrical and service facilities, was also necessary to serve the new repair plant. The former machine shop has been converted into a blacksmith shop and a yard crane runway with a 10-ton crane is provided between this and the locomotive shop to serve both.

The locomotive shop is a brick and steel frame building 432 ft. long by 165 ft. wide. It is divided longitudinally into two bays of nearly equal size, one of which is designed for an erecting and boiler shop bay, while the other is given over to machine tools.

The erection bay is traversed by three through tracks, each of which runs over an engine pit at the incoming end. Two 120-ton Whiting overhead traveling cranes span the bay on a runway the full length of the building. These cranes can lift a locomotive at any point in the erecting bay and place it at any other point, permitting full use of the erection space.

The far end of the erecting bay is used as a boiler shop, so that the latter is served by the cranes which also serve



Section Through the Locomotive Shop at Denver

the unwheeling and erecting space. A narrow platform or balcony extends the length of the bay on the side toward the shop for the storage of locomotive parts. This balcony is also served by the large cranes, each of which is provided with a light auxiliary hoist on the shop side of the main hoist for handling parts.

The transportation of parts about the shop is handled by interlocking crane and truck systems. The machine tool bay is served by a 10-ton overhead traveling crane. This crane serves directly all of the machine tool bay that is not under the balcony, as well as the inner seven feet of the balcony, and is used both for transferring parts between the two levels and for longitudinal transportation on either level.

Both storage battery electric trucks and gasoline tractors with trailers are used for transporting parts between the bays and to locations inaccessible to the cranes. These trucks are also used to bring raw materials into the shop and to carry finished parts outside for stock storage or for shipment to other points. Easy operation of the trucks is assured by the installation of creosoted block floors on a reinforced concrete base.

A 50-ft. yard crane runway and storage bay, extending the length of the shop and several bays beyond on the machine tool side, facilitates the handling of materials and parts into and out of the shop, beside providing liberal handy storage space. The crane, spanning the full bay, can load or unload trucks at any point. A track extends three car lengths under one end of the craneway to allow for the easy unloading of materials from outside and the loading of parts for other points. Two extensions of the shop balcony into the craneway permit the handling of materials back and

forth between the craneway and the shop balcony direct. All transportation, both external and internal, is thus tied together into a compact, interlocking, free moving system.

The efficiency of the workmen is facilitated by providing the best possible lighting, both natural and artificial, well distributed throughout the shop. Large wall sash of Truscon design are provided on all sides and in addition an overhead monitor extends practically the full length of the building over the center of each bay. Heating is provided by a system of unit hot blast heaters distributed along the wall and bay lines through the shop. Complete service facilities, including lockers, are located on both the main floor and the balcony at points as nearly central as possible to the men served by each of them.

The blacksmith shop is reconstructed from the old machine shop and also lies adjacent to the crane runway opposite the locomotive shop. This shop is also tied in with the general transportation system already outlined. In addition, a standard gage track extends from the erection bay of the locomotive shop into the blacksmith shop for the transportation of heavy forgings back and forth.

This shop is given over to forging and heat treating, with a well organized spring manufacturing and assembly department, an acetylene cutting and welding department and a brass foundry. Like the locomotive shop, the blacksmith shop is also highly departmentalized and considerable thought has been given to reducing manpower and lost motion to a minimum.

The Machine Tool Layout

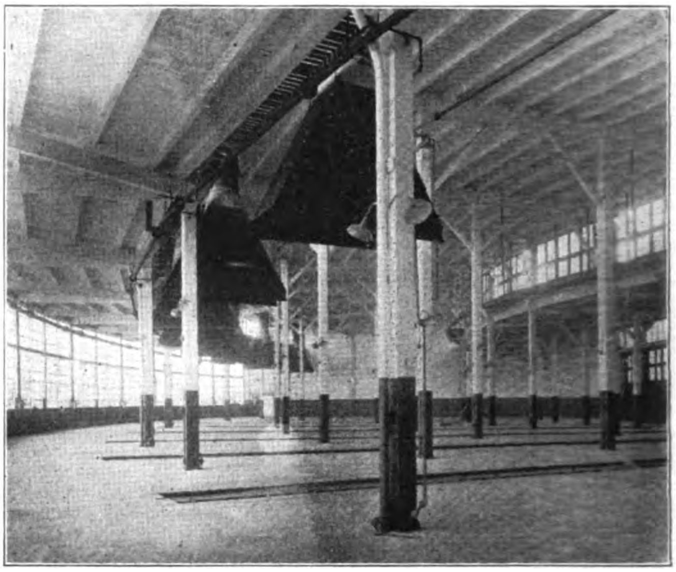
In the layout of departments and machine tools particular attention was given to the relation between the various subdepartments and tools were grouped with the idea of making each department complete in itself as far as possible, locating tools serving more than one department so that such service could be made with the least movement of material.

The driving wheel department is located opposite the in the bay served by the 10-ton crane and in addition to the service of the traveling crane, jib cranes and hoists for individual machines have been liberally supplied.

The driving wheel department is located apposite the stripping track so that drivers are immediately delivered to the wheel department for tire renewals or for wheel turning, quartering, journal and pin turning or axle renewals. As soon as they are completed they are stored in the aisle between the wheel machines until they are to be assembled for box fitting. Machinery for box repairs is adjacent to the box fitting floor, conserving space and reducing movement on all box work to a minimum.

The rod work, located next to the box department, is served by the traveling crane and jib cranes, and is also located close to the assembly floor. Floor space in the storage of rods is conserved by means of "A" frame racks, so designed that all rods can be easily stored and delivered without interference. This department is also located close to the thoroughfare to the blacksmith shop, making movements to that shop simple as possible.

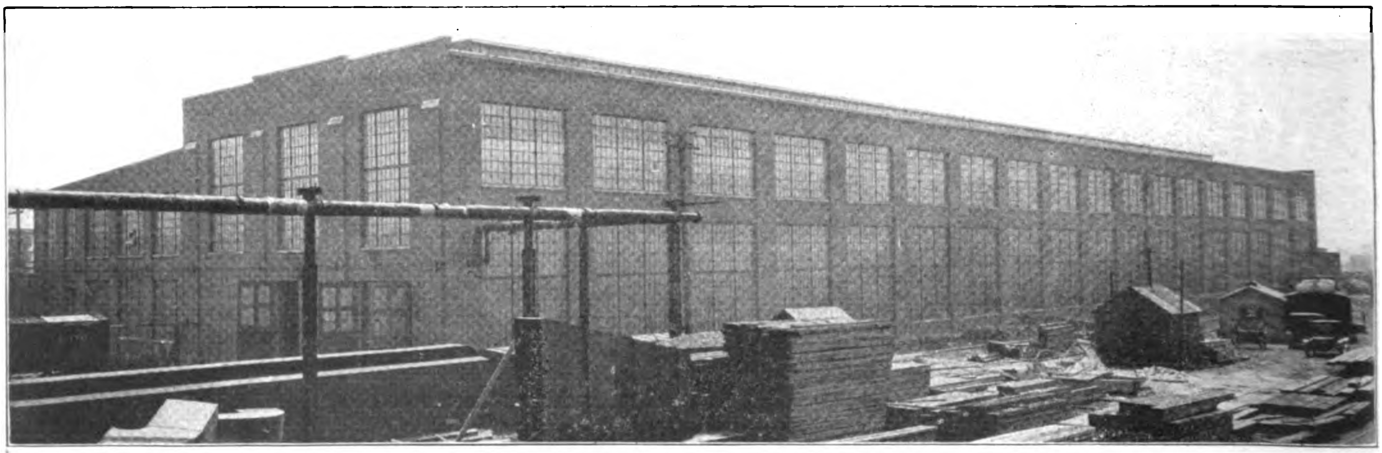
The tool room is composed of a tool storage space on the ground floor, with a repair and manufacturing department on the balcony. Communication is furnished by means of a small elevator, by which cutting tools, air tools, etc., may be delivered to the repair and inspection floor. Cutting tools are kept to form by use of water tool grinders, in which all are ground to shape and kept in stock. Immediately adjacent to the balcony tool room is an erecting floor for machine tools and other equipment, to be maintained under the supervision of the tool room foreman, to facilitate the work of keeping machine tools in good repair.



Interior of the Salt Lake City Engine House, Showing the Natural Illumination

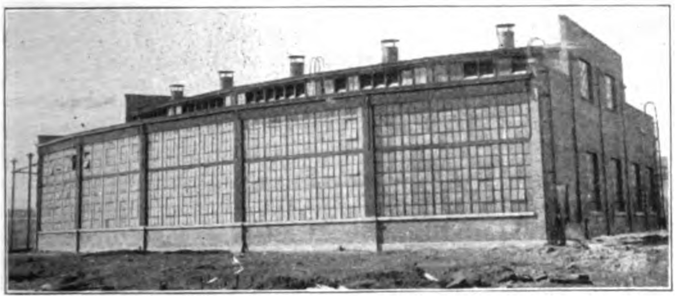
Locomotives requiring heavy frame work and new cylinders are located in the erecting bay opposite the group of tools assigned to the work of machining these parts. These tools are also located adjacent to the thoroughfare to the yard crane and blacksmith shop to provide short movement to the yard crane and to the smith shop.

The balcony on which are located the various departments requiring lighter machinery is provided with a continuous landing platform under the heavy machine bay crane, on



Exterior of the Denver Locomotive Shop

which all parts may be landed at any point, and has in addition two landing platforms under the yard crane runway. Advantage is taken of this latter point in locating the flue welding department in the balcony in the boiler shop end of the building. Flues are handled from locomotives in a movement across the shop to the rattler under the yard crane, being deposited in a barrel rattler designed to load and unload its entire capacity each with one move. Flues are lifted from the rattler by the yard crane directly to the landing platform, where they are placed upon specially designed flue trucks, holding just the capacity of the rattler. In this way the flues are not handled singly except as they are safe-ended or cut to length. From the welding department they can be returned



The Alamosa Engine House Shows Typical Construction in Which Large Areas of Glass Are Used

to the yard crane runway for storage, or delivered from the balcony direct to the boiler shop floor by the messenger crane.

Pipe benches and tools for locomotive pipe work are located near the erecting pits, so that pipes may be repaired and erected with little lost movement.

In the purchase of new machine tools for this shop special care was given in the selection of tools, taking into consideration the use, character and quality of the tools best adapted to the work, with due consideration as to outlay. Particular

motives will be under repair at one time than has been necessary with the old facilities.

Other Facilities

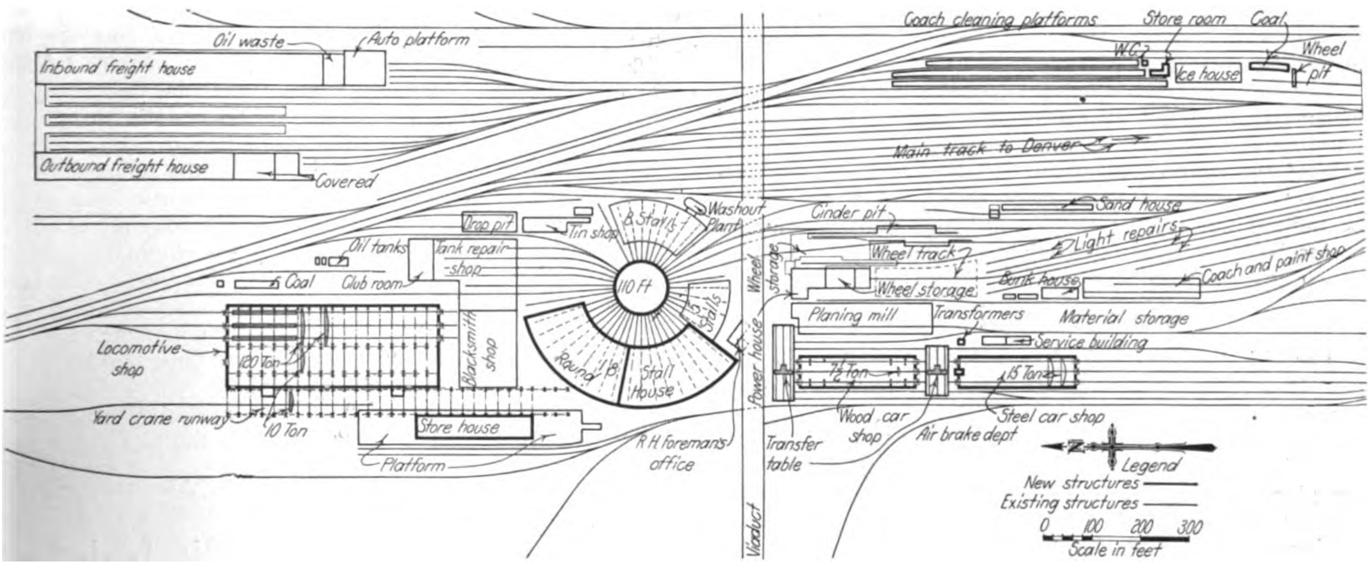
To provide the necessary increase in boiler capacity, a 45-ft. by 46-ft. extension has been built on the south side of the old boiler house, and 600 hp. additional boiler capacity installed, bringing the total capacity to 1,600 hp. at normal rating. Stokers, feed water regulators, pumps and other modern equipment have also been installed, and a 225-ft. radial brick stack, new breeching and adequate ash handling facilities make the whole into a modern efficient plant.

The power requirements of the shop and terminals are supplied from outside. The increased power demand called for increased transformer and distribution capacity. To provide this, two new transformer houses have been added, so located as to minimize the length of the distribution lines.

Acetylene cutting and welding equipment is installed in the enginehouse, locomotive and blacksmith shops. This equipment is supplied through overhead pipes from an acetylene house on the west side of the yard, well away from other buildings.

The existing engine terminal had a 7-stall and a 29-stall enginehouse, served by a 100-ft. turntable. Twelve stalls of the latter house were used as a locomotive shop and were not available for regular enginehouse service. By throwing all shop work into the new locomotive shop, these stalls are released for regular enginehouse service. A 50 per cent increase in effective enginehouse capacity is thus attained without building any additional stall space. This is amply sufficient to take care of the requirements of the present and the immediate future.

In laying out this plant, consideration has been given not only to present requirements, but also to requirements several years in the future as well. The shops are all so located as to be susceptible of substantial extension without any change whatever in the general scheme, and with a minimum



The Shop Layout at Salt Lake City

attention was given to the development of grinding and milling operations in place of planing, as far as these operations could be practically applied to locomotive repair work.

The routing of locomotives through the shop from the stripping pit back to the assembling pits is worked out with the least loss of movements of the various parts taken as a whole. With the planning system of scheduling repairs to all parts it is expected that the days in the shop for each locomotive will be very greatly reduced, and therefore fewer loco-

of interference to operations. The extension of the boiler house is large enough to permit the installation of 600 hp. additional boiler capacity. The same provision for future as well as present extensions has been carried out in the construction of sewer, water and other service facilities.

The Salt Lake Installation

The new development at Salt Lake follows the general plan of the layout at Denver. At Salt Lake, however, the

heavier grades and the greater curvature in the tributary territory call for heavier boiler, tire, driving box and other heavy machinery repair work, so that more space has had to be given to these departments. An increase in storehouse space was also found necessary and the increasing number of 2-8-8-2 heavy Mallet locomotives called for an enginehouse of longer stall construction than that of the existing enginehouses to permit their rapid and economical handling. The arrangement of the existing yard also made the new Salt Lake development somewhat more difficult than that at Denver, and required the departments to be grouped in a different manner.

A locomotive shop, a steel and a wood car shop and a yard crane runway have been built of substantially the same design as those at Denver, together with a two-story storehouse, 50 ft. by 242 ft., and an 18-stall enginehouse, 126 ft. deep. As to Denver, the existing machine shop has been converted into a blacksmith shop, while an existing erection shop has been converted into a tank shop and a number of consequent additions and alterations have been made to other departments.

Locomotive Shop Resembles That at Denver

The locomotive shop is of the same design and track layout as that at Denver. The tool department layout also copies that at Denver, though some of the individual tools are somewhat different, on account of the different class of locomotives to be handled. This shop is also served by two 120-ton Whiting cranes with 10-ton auxiliary hoists in the erecting bay and by a 10-ton crane in the machine tool bay. Electric and gasoline trucks also serve to transfer parts between the two bays and between the shop and the yard crane runway.

A yard crane runway with a 15-ton crane extends the full length of the shop along the machine shop side of the building and serves as a receiving and storage space for parts and materials. Beside the tracks already referred to two standard gage tracks extend through the shop and into the runway at right angles. These serve for the transportation of heavy parts. One of the yard tracks extends about 300 ft. from the north underneath this crane runway, for loading and unloading cars from outside.

The runway extends several bays beyond the end of the locomotive shop and also serves the blacksmith shop. This building was formerly the machine shop and lies on the same side of the runway, about 40 ft. clear to the south of the locomotive shop. This shop is equipped and departmentalized like that at Denver, although the different shape of the building calls for a slightly different arrangement of the groups, and no brass foundry is required at Salt Lake.

Storehouse Was Rebuilt

The old storehouse, which was located on the side of the new locomotive shop, was no longer adequate for present needs. It was consequently torn down and a larger two-story storehouse, 50 ft. by 242 ft. was built in its place. This is a brick and timber mill construction building. Following the plan of grouping buildings as far as possible around the crane runway, it is located alongside the latter opposite the locomotive and blacksmith shops.

The storehouse is entirely surrounded by a concrete paved platform at car-floor level. This platform is 10 ft. wide along both sides of the building and is about 450 ft. long, providing liberal outdoor storage space at both ends of the building. The entire length of the east 10-ft. of this platform is under the crane runway and is also served by the yard track under the runway, which is located next to the platform. The west side of the platform is served by another yard track throughout its length, giving ample unloading space.

The first floor of the storehouse is given over to storage space and the storekeeper's office. Only half of the second story, however, is storage space, the balance being given over to executive offices of the terminal. A centrally located elevator and stairway provide for vertical transportation.

The old engine terminal had an enginehouse of 5 stalls, one of 8 stalls and one of 16 stalls, all served by an 80-ft. turntable. While the number of stalls available was substantially sufficient for present needs, the length of stall in none of them was sufficient for adequate, economical service to the longer locomotives, of which increasing numbers are being assigned to the lines tributary to Salt Lake. Consequently, the old 16-stall house was torn down and its place taken by a new 18-stall house, 126 ft. deep on the same site, the old 80-ft. turntable being replaced by a new 110-ft. continuous turntable of American Bridge Company design and manufacture.

Enginehouse Includes Novel Features

As past experience with timber and concrete frame enginehouses has not shown advantages in concrete commensurate with its much greater first cost as compared with timber and as a well-built timber enginehouse of fire-resisting mill construction rarely burns, this new enginehouse is built of brick and fire-resisting mill construction and is divided into two equal parts by a fire wall. It is provided with a clerestory about 70 ft. wide, placed well toward the rear of the house, fully glazed on both sides and with operating sash to give good ventilation.

The economical and rapid handling of heavy modern engines with their greater weight of parts demands some kind of mechanical equipment for the dismantling, transportation and reassembling of these parts. Jib cranes and overhead cranes have been used for this to some extent, but their high cost, comparative slowness and lack of flexibility threw the balance in favor of the use of crane trucks for this purpose. These trucks, capable of picking up parts quickly at any point and transporting them to any other point inside or outside the house without transfer and independently of tracks, are rapid, flexible and economical.

To insure the satisfactory, permanent operation of these trucks, a paving brick floor on a reinforced concrete base was laid throughout the building. The use of reinforcement in an enginehouse floor is rather unusual, but a scheme was worked out whereby the reinforced floor slab, acting as a beam extending from pit to pit, and tied in with the reinforcing in the pits, stiffened the pits and took part of the jacking loads from them so that a much lighter cross-section of pit could be used than would otherwise be required. This reinforced floor slab also permitted the elimination of the concrete piers under the interior building posts, the latter being carried directly on the slab. Thus the whole floor and pit system, though much stronger, was no more expensive than the massive pits, unreinforced floor and building piers that would otherwise have been used.

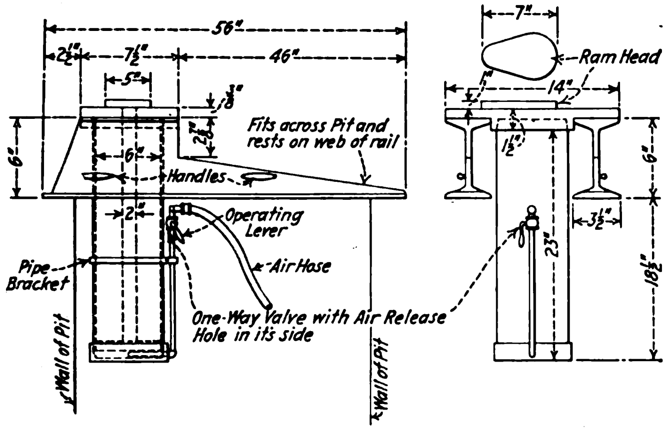
The building is heated by direct radiation, coils being distributed under ledges at both sides of the pits and around the rear wall.

Shoe and Wedge Pit Jack

SHOE and wedge men find the device shown in the illustration very convenient in fitting shoes and wedges and with it pedestal binders are easily raised into position. With this jack two men can quickly apply the shoes, wedges and binders on the largest locomotives. It is useful both in the enginehouse and back shop.

The jack consists of a six-inch air cylinder in which a five-inch ram head works on a two-inch piston rod. The air is admitted to the bottom of the cylinder by a one-way air valve. The valve contains an air hole through which the air is released when lowering the jack. At the top of

the jack there is a 7½-inch collar under which fits a bracket or casting which spans across the pit and rests on the web of the rail. This bracket contains two handles by which



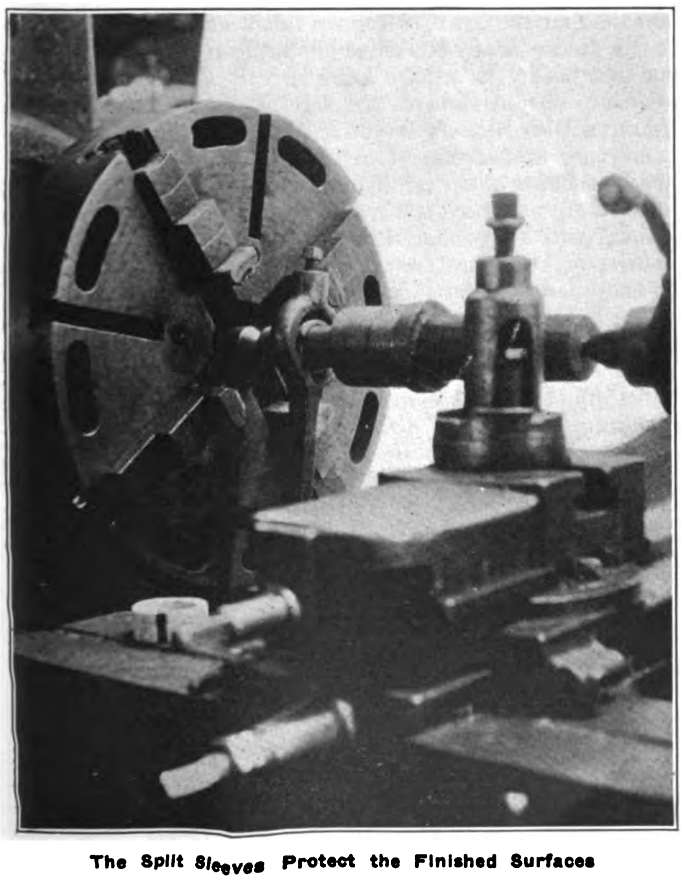
Pit Jack for Rapidly Placing Shoes, Wedges and Pedestal Binders in Position

the jack may be moved. After one pedestal binder is put up in position it is an easy matter to slide the jack along the top of the rail to the next binder.

Holding Lathe Work Without Injury

By Lloyd R. Carson

In turning such work in a lathe as a brake hanger pin, valve stem or other work necessitating the reversal of the part end for end in the lathe the mechanic often finds it necessary to use a lathe dog in order to allow the work to run on the centers and still run true. In many cases the set screw of the lathe dog makes a flat spot on the work, and, on any part such as a valve stem which requires a steam


The Split Sleeves Protect the Finished Surfaces

fit or polished surface, this is injurious. Moreover should the work in any way catch or cease to rotate, the set screw will gouge it. This is true not only of the set screw in a lathe dog but also of the jaws of a chuck.

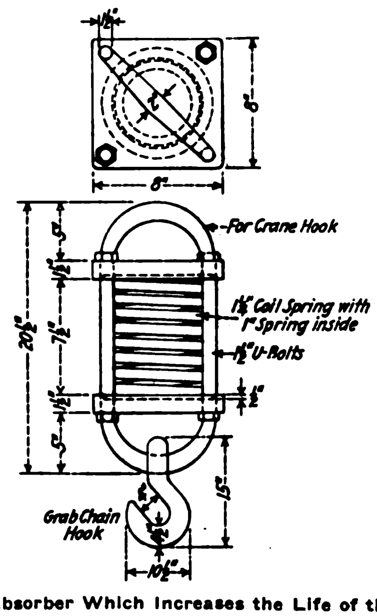
The following method has proved to be a remedy for these drawbacks of the lathe dog and allows the mechanic to place the work in a chuck, should he wish to true his work up in that manner.

Take an old bushing which has been discarded, or the ends of bushings which have been removed in cutting off new bushings after they have been turned and bored. Place in a vise and with a hack-saw remove ¼ in. or ⅜ in. from the entire length of one side. File the edges so as not to leave a rough edge on the inside of the bushing. This makes a split sleeve which can be slipped over the work, and the lathe dog or chuck jaws tightened down on it. The mechanic will find that when the lathe dog or chuck is tightened this collar will bear at all points on the work, thus allowing a heavier cut without fear of injuring the work.

In a surprisingly short time pieces can be found to suit the requirements of any size work. It is not necessary to have the sleeves the exact size of the work because the metal removed in cutting the sleeve provides for some closing in to suit the work. These collars can be used many times on different size work as they spring back to their former shape when removed. They will also be a great help in holding work in a vice or shaper where it must be held firmly without injury.

Crane Shock Absorber

There is in use at the Lehigh Valley Shops at Sayre, Pa., a crane shock absorber for which it is claimed that since it has been applied there has never been found a broken chain or a cable. It is hung on the crane hook and the grab chain hook is attached to the pick-up chain. This arrangement places it between the crane and the work which



Crane Shock Absorber Which Increases the Life of the Crane Cable and Lifting Chains

is to be lifted. It receives all sudden shocks and strains caused by the jerking and twisting of the object as it is being raised. The elimination of these shocks prolongs the life of the crane cable, chain and crane.

The device is very simple in construction and can be readily made in the blacksmith shop. The most important parts are the two helical coil springs. These springs are tested to withstand a load equal to twice the capacity of the crane.

Proceedings of the Boiler Makers' Convention

The Discussion Developed the Advantage of the Interchange of Ideas on Boiler Construction

THE proceedings of the opening session of the fifteenth annual Convention of the Master Boiler Makers' Association, which was held at the Hotel Sherman, Chicago, May 20 to 23, were published in the July issue of the *Railway Mechanical Engineer*, and abstracts of the papers on the application of Thermic Syphons and Autogenous Welding and Its Uses were published in that issue. Other papers presented during the convention are abstracted below.

Training Apprentices

The great need of this country today is a revival of respect for genuine old time skilled craftsmanship. There is a growing conviction among thoughtful men that a grave mistake has been made in making apprentice restrictions too drastic. It requires youth and vitality to make anything a success these days, and the skilled trades are no exception to the rule.

It is recognized that the best results in apprenticeship can only be accomplished by educational facilities on the shop property during working hours with the apprentice under pay, combined with shop instruction, conforming to a regular schedule of advancement.

Never was there so great a need for skilled mechanics as there is today, but we cannot develop real mechanics unless a definite and adequate plan of training is adopted and rigidly adhered to. A thorough course of training for each trade must be laid out and some one must be responsible for seeing that each boy is carefully conducted through the course. There must be a definite amount of school instruction in order that the boy may be given a thorough understanding of the underlying principles of the job. Means must be provided to insure thorough training of the apprentice in the shop work, by the use of shop instructors who devote their entire time to the instruction of the apprentices, directly on the work in which they are engaged in the shop. It has been demonstrated that the use of a shop instructor as indicated, results in a material increase in output, and is therefore immediately profitable to the railroad company, as well as ultimately beneficial in providing a group of well trained and well intentioned graduates to fill the places made vacant by promotion or other causes.

It has been found that the best results in apprenticeship training are accomplished by a plan embodying instruction in the standard practices of the railroad company and all lesson papers and shop instructions should be arranged with that object in view in order to thoroughly drill the apprentice in the company standard practices, at the same time he is being taught drawing, mathematics, and shop methods.

A number of railroad companies have a very complete apprenticeship system extending over the entire railroad and in successful operation for a number of years. Usually there are three groups of apprentices, as follows:

Classes of Apprentices

Regular apprentices should be boys 16 to 21 years of age, having a high school education or equivalent, and in good health. Schools be maintained at the shops, four to six mornings per week. Attendance be compulsory and under pay, but the minimum requirements not severe. Each apprentice be given instructions in mechanical drawing, shop mathematics, physics and related subjects during two periods of two hours each per week. It will be realized that many boys who have not had much early education, still have good intentions and respond to a genuine opportunity to improve their condition by attending the schools. The course in each of the mechanical trades is for four years in school and shop. The shop to have an instructor to supervise the movements of the apprentices in the shops, give them instructions in the proper methods to follow and arrange for them to be moved in accordance with the schedule established for each trade. The shop instructors should not assign work, but instruct the apprentices in the work which the department foreman has assigned to them.

The lesson papers, drawings, problem sheet, T-squares, angles, pencils, paper, and everything except the set of drawing instruments should be furnished by the company. The instruments can be purchased by the instructor for the apprentice at a reduced rate made with the manufacturers.

Helper apprentices should be young men 21 to 30 years of age, in good health, who have had two or more years' continuous experience as helpers in the shop from which application is made, should be given one year allowed time and serve a three-year apprenticeship course. Attendance at the school could be optional for helper apprentices. The shop instructors also should look after the progress of the helper apprentice.

Special apprentices should be young men 18 to 26 years of age, who are graduates of a mechanical engineering course in college and have good health. They can be placed on the regular work in the shops and assigned to special work on tests and selected duties as required. These men need not attend the shop schools.

Many men now occupying good positions in railroad service are graduate apprentices of different railroads, it may be said that the railroad service offers as good opportunity for the future as any other line of work. It should be pointed out that ability to acquire knowledge is not alone sufficient to insure advancement in the service; some other desirable characteristics such as executive ability, initiative and common sense are necessary, and are sometimes unexpectedly developed after a period of experience. Many of these men have been advanced to good positions. This plan, we believe, will help materially to increase the bond of mutual interest between the company and the employees.

The plan of apprenticeship should include the boilermaker's trade with others, in the manner described. This trade should be more attractive to young men than heretofore on account of the introduction of labor saving tools and appliances and improved methods. There is an excellent opportunity for young men who are thoroughly qualified to advance beyond the position of workman.

This report was signed by the following committee: George B. Usherwood, N. Y. C. (chairman), W. J. Murphy (Penn. System), John Harthill (N. Y. C.) and John F. Raps (I. C.).

A Paper on Welding

By A. G. Pack

Chief of Bureau of Locomotive Inspection

I recognize that autogenous or fusion welding is among the most valuable modern discoveries when used with good judgment and discretion, however, it has not yet advanced to a stage where it can be considered "a cure-all."

I do not believe that it should be used on any part of the

locomotive boiler where the strain to which the structure is subjected is not fully carried by other construction, which meets with the requirements of the Locomotive Inspection Law and Rules which are based on recognized standard practices of the best authorities, nor on any other part of the locomotive which is subjected to severe strains and shocks where through failure, accident and injury might result. This will be my position until its reliability has been established beyond a reasonable doubt, or until some means is discovered whereby the value of the weld can be established before failure occurs.

It is too well recognized that the value of welding varies with the different welding operators, and even with the same operator, to give it a definite value.

It is further established that autogenous welding changes the structure of the material to which it is applied to such an extent that the material cannot be depended upon as retaining its original physical properties. The welding of seams or cracks in the boiler backhead, where men are constantly employed in close proximity, should never be permitted except where the welding is covered with a patch secured by patch bolts, studs, or rivets. Some of the most serious accidents have been investigated by the Bureau of Locomotive Inspection where welded seams in boiler backheads failed, which has led me to this final conclusion.

Our records, as kept by years, show for the period July 1, 1915, to April 30, 1924, the relative effect of crown sheet failures in which the sheets pocketed or bagged as compared with those in which the sheets tore. The term "involved," as used in our study, refers to seams that were included in the pocketed, bagged or ruptured area.

During the period July 1, 1915, to April 30, 1924, inclusive, there were 495 accidents due to firebox crown sheet failures which resulted in the death of 326 persons and the serious injury of 761 others, or an average of 0.66 killed and 1.54 seriously injured per accident.

In 286 of the 495 failures the sheets bagged or pocketed, but did not tear, as a result of which 48 persons were killed and 474 others were seriously injured, or an average of 0.17 killed and 1.66 seriously injured per accident.

In 209 of the failures the sheets tore causing the death of 281 persons and the serious injury of 336 others, or an average of 1.35 killed and 1.61 seriously injured per accident.

It will be seen from this comparison that the fatalities where sheets tore have been eight times as great as where they did not tear. From the viewpoint of safety to persons, this very clearly illustrates the necessity for constructing firebox sheet seams in the strongest practical manner, especially so in the "so-called low water zone," or such seams as may be within 15 inches of the highest part of the crown sheet, measured vertically, the purpose being to keep the welded seams, 78 per cent of which have failed when undue strain was thrown upon them, below that part of the firebox which pulls away from the stays causing pockets or bulges of various depths in cases of low water.

Of the 495 crown sheet failures referred to there were 277 cases where the riveted seams were involved, where 44 or 15.9 per cent of the seams failed, while in 234 or 84.1 percent of the total riveted seams did not fail.

In the total of 495 crown sheet failures there were 132 cases in which the autogenously welded seams were involved, of which 103 or 78 per cent failed, while 22 per cent did not fail.

During the period July 1, 1915, to April 30, 1924, autogenously welded seams were involved in 26.7 per cent of the total crown sheet failures, while 50.7 per cent of the total fatalities occurred in such accidents where the autogenously welded seams were involved.

It will be seen from this that 15.9 per cent of the riveted seams failed, while 78 per cent of the autogenously welded seams failed under exactly the same conditions. The average number of persons killed per accident in which the riveted seams were involved was 0.76 as compared with an average of 1.17 killed per accident where the autogenously welded seams were involved.

It may be said that a large percentage of the crown sheet failures involved in the discussion were caused by overheating due to low water, therefore, the primary causes of such failures were overheated crown sheets, and that nothing can prevent a crown sheet from coming down when allowed to become extremely overheated, with which I agree. But when a stronger construction of the firebox seams will reduce the number of fatalities and the damage to property, I feel that there can be no excuse to offer for not employing the strongest and best practical methods.

I do not desire to be understood as opposing autogenous welding when properly and discreetly used, and believe that it has a very wide and useful field. If we are to profit by the experiences of others, we must give careful consideration to the result of all practices and methods. The extreme to which autogenous welding has been carried is what I have taken exception to. It is not "a cure-all," nor can it be used indiscriminately with safety, nor even economy.

Cost of Removing Mud Ring Rivets

The most economical method of cutting off and removing mud ring rivets is by the use of the gas torch in turning the rivet heads off, then backing them out in the regular way.

It is well known that some mud ring rivets are easier to remove than others. The hard ones are either drilled out or burnt out of the ring. Sometimes it is found advantageous to heat the mud ring, just above or below the rivets which are hard to back out. This expands the hole and in many cases makes the rivet easier to back out.

The cost of removing mud ring rivets depends upon several conditions. "Cost of gas, which shops buy, while others manufacture." Whether or not the rivets are hard, or easy to back out, as well as the class of labor used in doing the work and the price per hour paid such labor. However, as a fair estimate would say six cents per rivet plus the cost of gas would be a fair price.

This report was prepared by a committee composed of Charles P. Patrick, chairman; J. P. Malley, M. G. Guiry.

Removing and Renewing Firebox Sheets

The most up-to-date method of removing firebox sheets from a locomotive firebox is by the use of the oxy-acetylene torch and air ram. Rivets also are burned out with electric process in the flange of back flue sheet or door sheets. Cone head rivets can be burned off in mud ring with either electric or acetylene torch and air ram used to punch the rivets out of the ring.

Rigid staybolts that are riveted over at both ends can be drilled on the outer end of bolt or burned out. However, when the acetylene torch is used on this work great care must be taken by the operator to see that no damage is done to the outside boiler sheet.

When fireboxes have a full or partial installation of flexible staybolts and are equipped with caps and sleeves on the outside sheets, these bolts can be burned on the firebox side and driven out entirely free from the sheet. The same methods can be used when removing back flue sheets or door sheets only or applying new side sheets.

The cost of removing fireboxes is very largely dependent on the character of the shop doing the work. One shop may be up-to-date with all the latest appliances while another may be behind in this feature and therefore unable to compete with the up-to-date shop in matters of cost. However, the

advantage in cost is in the matter of methods between the use of electric or acetylene torch as compared with the former method of drilling staybolts and the use of sledge hammers and chisel bars is in favor of the torch, because it is more economical as well as effecting a great saving of time, which is equivalent to money. It assists in keeping to schedule time which is a saving in overhead expense.

Taking up the question, "Is it more economical to renew fireboxes without removing boiler from engine frame?" Having had experience in both ways of applying new fireboxes with boiler removed from the frames and applying new fireboxes without removing boiler from engine frames, two of us are in favor of removing the boiler from the frames whenever there is a new firebox to be applied, nothwithstanding there appears to be an added cost on account of having to remove the cylinder saddle bolts and a few pipes. We believe this cost is offset by the easier way in which the boiler maker can handle the work. The old firebox can be removed in a shorter time. The new firebox can be assembled and fitted together better than it can be when assembled in pieces in the boiler. Also, it does not matter whether the firebox is riveted together or welded together. The matter of cost cannot be entertained when applying new fireboxes to locomotive boilers; the best workmanship is what we want and we don't always know we get that when new fireboxes are applied to boilers that are not removed from the frames.

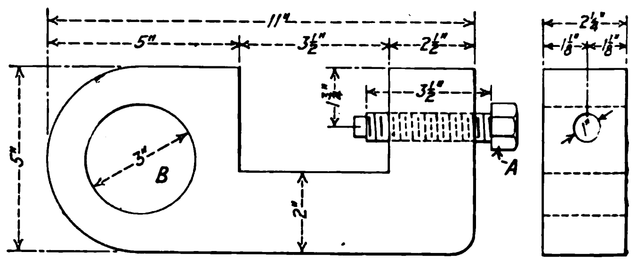
To give an estimated cost of applying new fireboxes to locomotive boilers for all railroad shops it appears to two of us that it cannot be done without doing an injustice to some shops that are not as thoroughly equipped for handling the work as are some of their neighbors. Two of the committee state it is more economical to renew fireboxes without removing the boiler from the frames. The firebox in their case is fitted together on the floor and assembled in the boiler by bolting the plates separately in place in the following order: Crown sheet, side sheets, then door sheet and tube sheet. The door sheet flange is provided with a shorter flange than when riveted and is welded entirely above the foundation ring. The tube sheet flange is treated similarly except where it is riveted in the ordinary way to the crown sheet. The crown sheet is welded to the side sheets. The joint of same is kept about 14 inches below the highest part of crown sheet. A patent welding method is used throughout, which has been employed for over three years, and it has given entire satisfaction without attention or failure. At the least, the cost of removing and replacing the boiler on the frames is saved by this method. One member of this committee quotes a cost of 21 cents per pound for labor and material charges between the incoming test of the boiler and its completed test, figured from the 1923 schedule of rates and material. This includes the store material and overhead, but excludes the shop overhead expense. He also favors a comparison of costs where shops are equally equipped for the performance of the work and claims a longer life for side sheets when the heavier crown sheet does not extend to include the side sheets. One member of committee suggests that it would be better to drive mud ring rivets with air hammer and air jam than to double gun them in order to be better able to remove them when necessary.

This report was prepared by a committee composed of Thomas Lewis, chairman; A. S. Greene, J. T. Johnston, T. W. Lowe.

Crane Lifting Clamp

The clamp shown in the illustration is useful to mechanics who work on heavy castings such as cylinder saddles, deck castings, etc., which have to be handled by a crane.

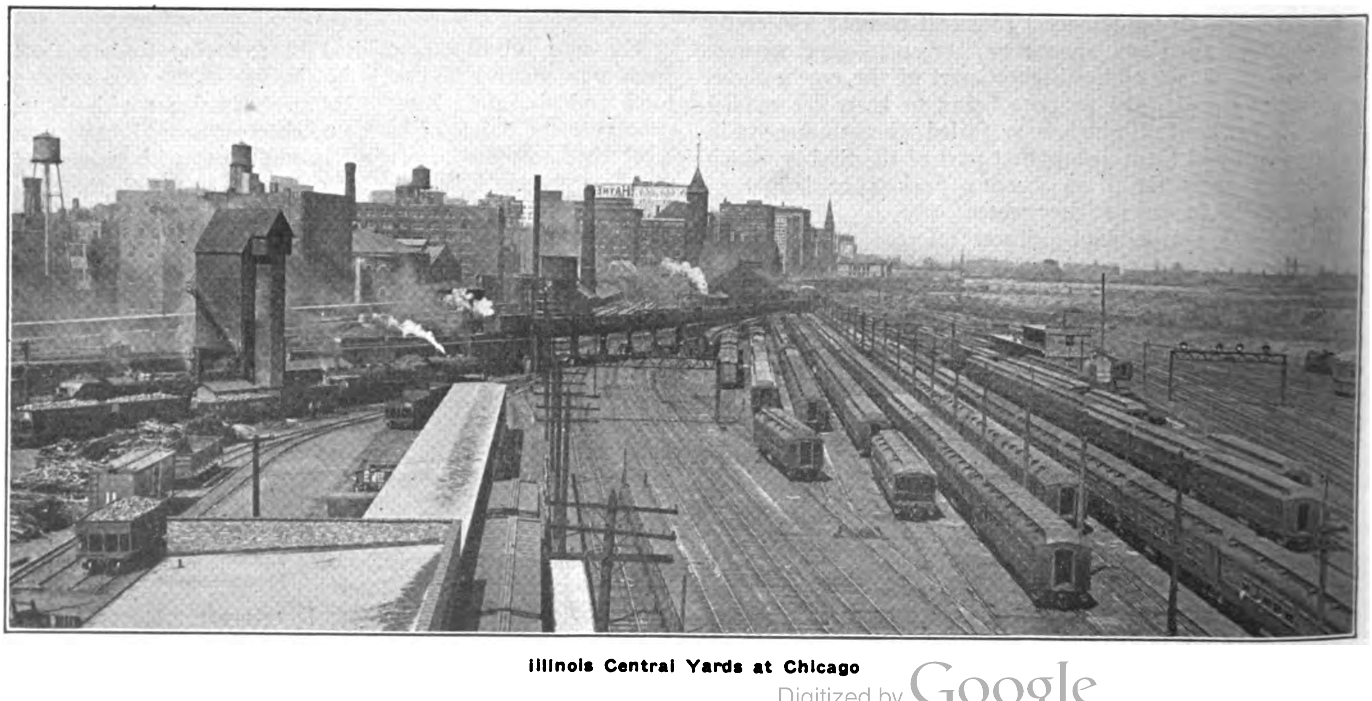
The clamp is fastened to the casting by the set screw *A* and lifted by the crane chain hook through the eye *B*. This



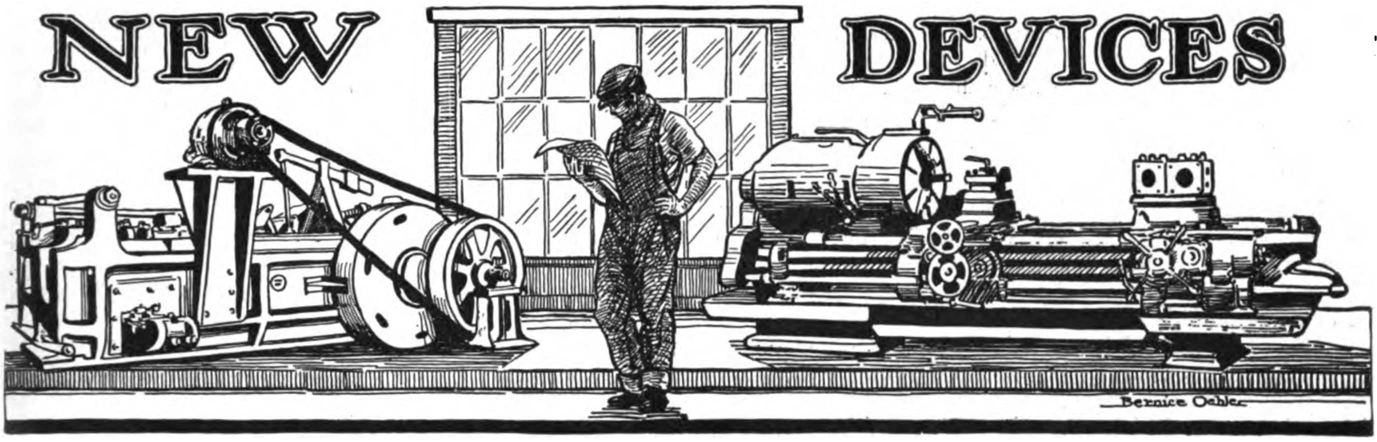
Clamp for Lifting Heavy Locomotive Castings

is much easier and quicker than by wrapping a heavy crane chain around a casting for a lift.

In handling cylinders for machining, this clamp can be fastened to the ribs of the casting so that it is possible to set the casting in practically any desired position.

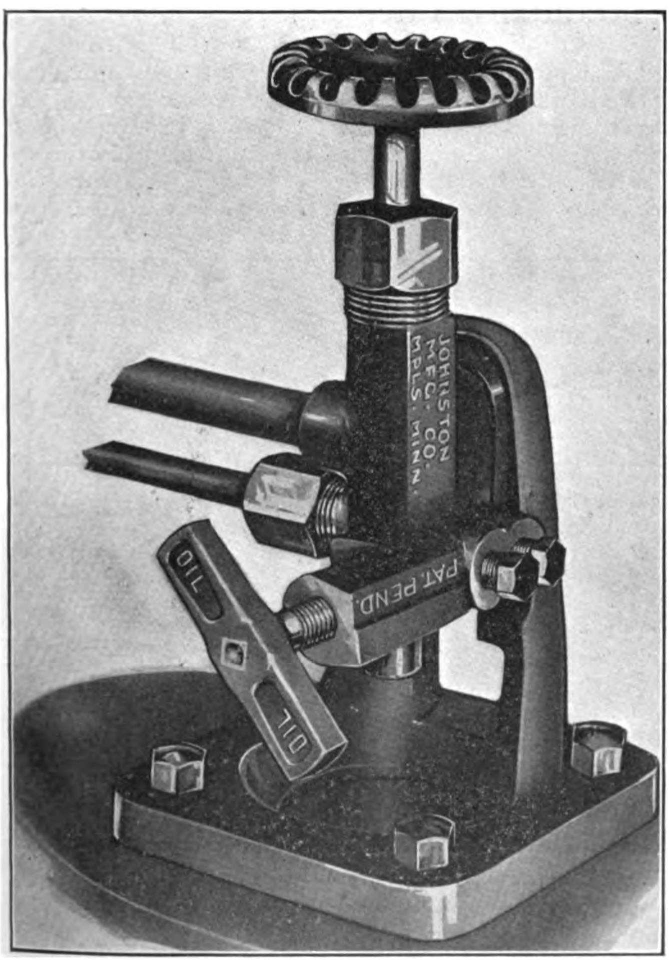


Illinois Central Yards at Chicago



Non-Clogging Vacuum Oil Burner

A NON-CLOGGING vacuum oil burner which contains no oil valve or small oil passages has recently been designed by the Johnston Manufacturing Company, Minneapolis, Minn. The oil supply to this burner is regulated indirectly by an air valve which rarely clogs and maintains a uniform flow. There is no choke or restriction in the oil passages. This burner operates continuously without variation or clogging on oil containing considerable free carbon and dirt.



Johnson Vacuum Oil Burner Consisting of Only Two Working Parts

The burner has only two working parts. These are the two needle-point air valves, one which regulates the compressed air and the other which indirectly regulates the oil feed. The oil regulating valve is clearly marked and is operated the same way as any other valve. In order to handle very thick oil, the burner has a high vacuum and large oil connections. It is designed so that the oil feed automatically increases and decreases with the air pressure and a proper and uniform flame is maintained regardless of large variations of pressure in the air lines. The operation of the burner is not affected by wear of the parts.

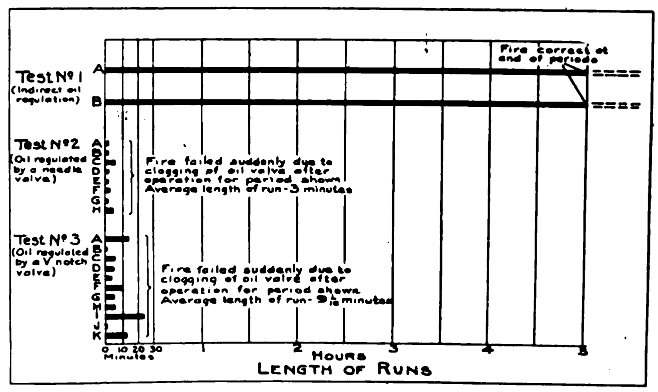


Fig. 1—Lengths of the Various Runs with Each System of Oil Regulation

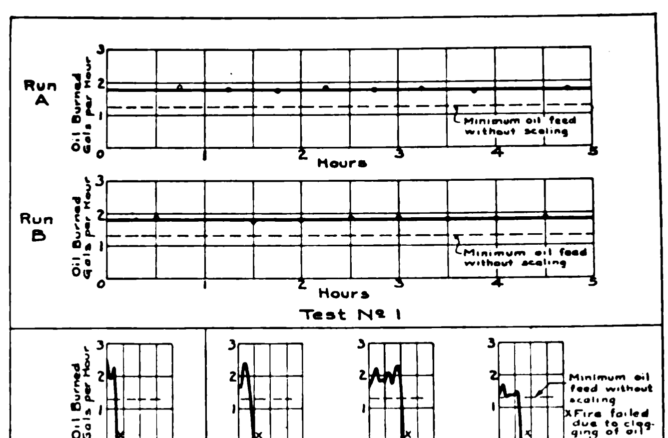


Fig. 2—Rate of Oil Feed in Gallons of Oil Burned Per Hour

The Johnston Manufacturing company sponsored at one

of the leading universities a series of tests dealing with the relative merits of oil burners as used on a rivet forge. The object of these tests was to compare the abilities of various kinds of burners to operate on oil which contains considerable sediment and free carbon. The length of time a burner would maintain a fire without attention, or readjustment of the oil feed, and the uniformity of the oil feed and of the gases in the heating chamber during each run, were considered to be the correct measures of the ability of the burner to operate under the given conditions.

In Fig. 1, the lengths of the various runs with each system of oil regulation are shown graphically. The lines for the burner with indirect oil regulation have been shown dotted beyond the end of the five-hour test periods, since this burner was shut down only because the end of the working period of the shop had been reached. In Fig. 2 the rate of oil feed in gallons of oil burned per hour are shown graphically. All curves for the oil feed are plotted to the same vertical and horizontal scales.

The burner with indirect air valve regulation of the oil feed maintained a constant flame without visible evidence of variation during both of the five-hour test runs and would apparently have continued indefinitely without variation. With oil regulation by means of a valve of either the needle or V notch type, the oil feed fluctuated so rapidly that measurements of the amount burned could be obtained for only a few of the longest runs and the flame varied between a smoky and a scaling condition. After operation with valve control for a very short time, the valve clogged and the fire suddenly failed. The fluctuations in the oil feed under valve control were evidently due to the free carbon and sediment partially bridging across the valve opening, then breaking down, and finally bridging over the opening entirely so that the fire failed.

Inasmuch as scale is produced by free oxygen in the gases in the heating chamber, the oil feed should be maintained continuously above the quantity necessary to combine with all the oxygen in the air entering the heating chamber. This quantity for the burner as used in these tests is shown on the charts by the line marked, "Minimum oil feed without scaling." The oil feed was above this line continuously during both tests of the burner with indirect oil regulation. In the case of the burners having direct valve control of the oil feed, the feed fluctuated considerably and then suddenly dropped below this line. The length of these runs with direct valve control of the oil feed was variable, and constant attention would have been necessary to avoid scaling the rivets or creating a smoky condition.

Pratt & Whitney Speed Reducing Face Plate

A SPEED reducing face plate adaptable to its new 16-in. Model B lathe has been placed on the market by the Pratt & Whitney Company, Hartford, Conn. This face plate gives a six to one reduction to whatever spindle speed is engaged, so that extremely low speeds are available when the nature of the work demands them.

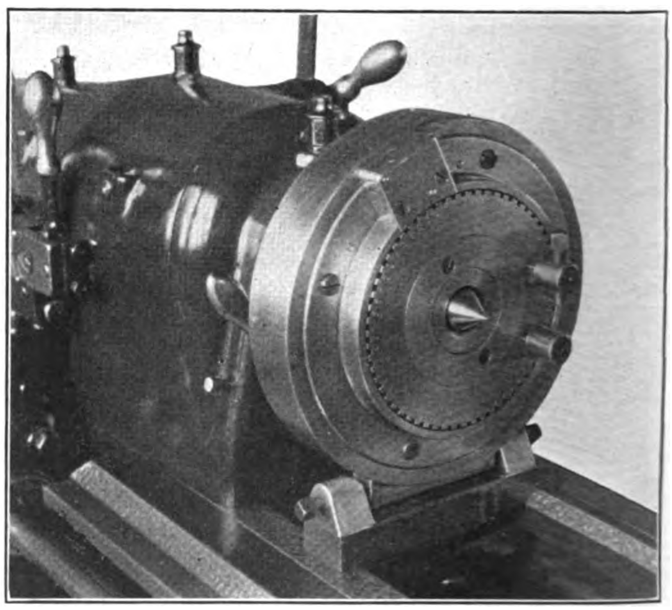
The new attachment takes the general form of a face plate. A gear is attached to the spindle nose. Attached to a plate which carries the driving dog, are two planetary gears which mesh with the spindle gear and a large fixed internal gear which is held from rotating by being clamped to the bed. The plate is thus given its reduced speed.

Owing to the fact that the regular headstock center which is mounted in the spindle nose is used for this attachment, the accuracy obtained with it is the accuracy of the lathe itself. There is no loss of alinement due to extra mechanism being inserted between the lathe spindle and the work center. The simplicity of the whole attachment makes it very easy to operate, and as it may be set up or taken off practically as quickly as a regular face plate, it forms a very convenient solution to some difficult turning problems.

The new attachment has many uses. It has been primarily developed for use in relieving operations of all sorts. This type of work requires a very slow spindle rotation in order that first class work may be accomplished, and as the attachment makes possible speeds as low as two revolutions per minute, the range of relieving work which may be accomplished with it is greatly increased. The relieving attachment for the Model B lathe has been designed in conjunction with the speed reducing face plate so that no additional relieving tables are needed. There are two differently speeded drives provided for the relieving attachment, one for use with the face plate and the other for ordinary relieving without it. Thus the same tables apply in either case.

In addition to its value in relieving, the slow rotation makes possible extremely accurate thread chasing because of the use of the headstock center without any intervening parts. This feature is of particular value in truing up precision screws.

A further use of the speed reducing face plate is the cutting of extremely long leads. There has been no difficulty experienced in cutting leads up to 12 in. on the Model B lathe equipped with this attachment. This opens up a range of work which has hitherto not been considered practical for an engine lathe. Large leads of this sort have been cut with a feed of .002 in. without trouble from chatter marks. The face plate is also designed to be used for accurate indexing. A plate with 60 notches gives every subdivision



Speed Reducing Face Plate Which Gives Speeds as Low as Two Revolutions Per Minute

needed for ordinary work requiring multiple starts. A convenient pawl engages the notches as desired, and each notch is numbered so that there is no difficulty in obtaining correct indexing. The indexing feature is particularly valuable for the multiple starts which usually accompany long leads so that this type of problem has been greatly simplified.

If desired, the gearing may be locked so that there is no speed reduction, and the attachment then becomes a regular indexing face plate.

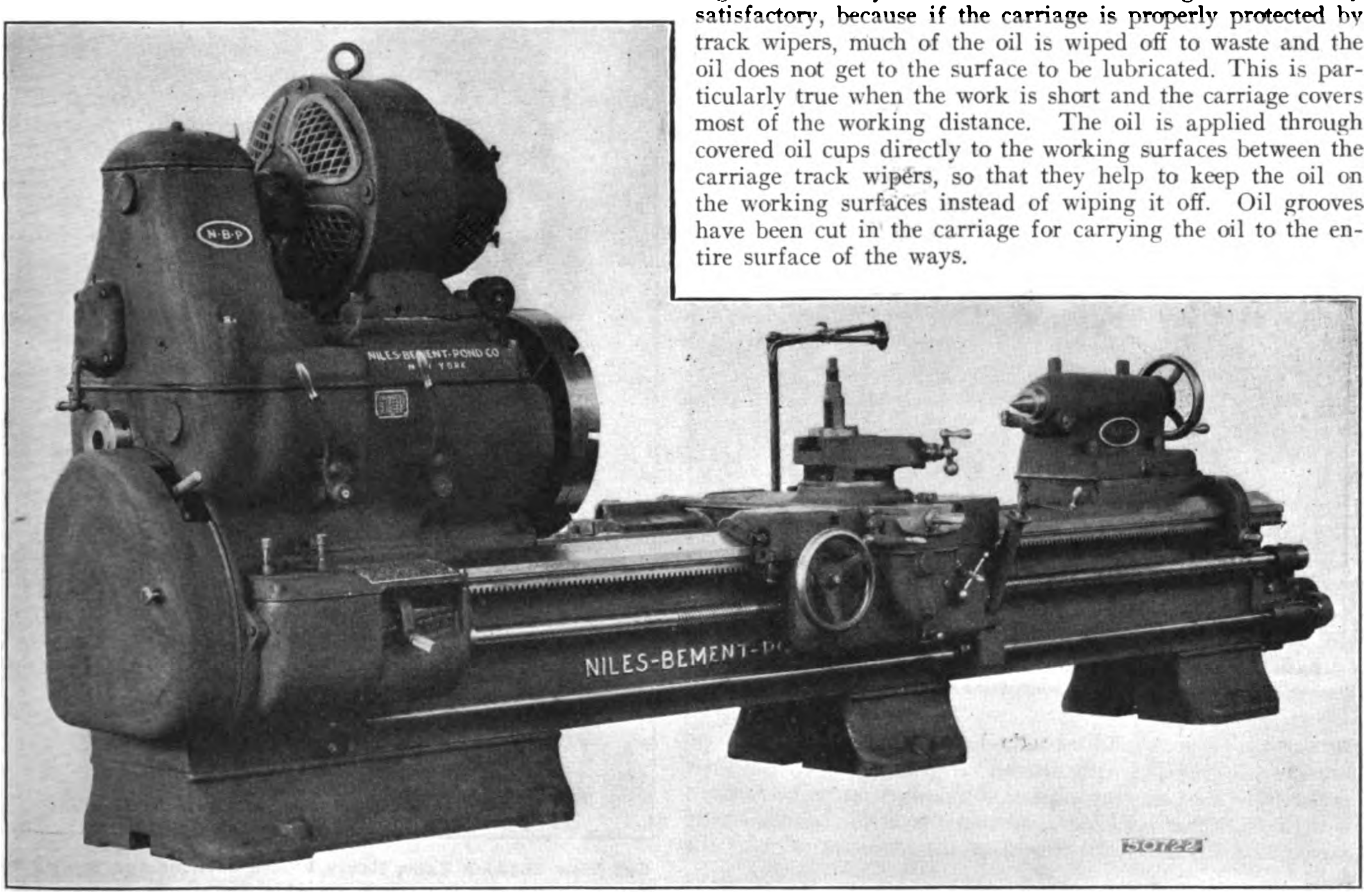
Heavy Duty Lathe Provided with a Rapid Power Traverse Screw

The primary object of the Niles-Bement Pond Company, New York, in designing the heavy duty lathe, here described, was to put on the market one which has more driving power, more strength and rigidity, greater ease of operation and greater endurance than any machine that this company has yet designed. Some of the salient features which tend to provide rigidity and strength are a bed which is cast with a solid web over the top to tie the two ways together, a carriage running on a heavy rigid tool slide; an apron provided with double walls and cast in one piece and steel gears which are all of the Maag design. The ease of operation is brought about by the rapid power traverse, a direct reading plate for selecting the desired feed, a "Jog" push button provided on the head for turning the motor slowly while shifting gears, and a thin apron which allows the operator to stand close to the work.

The bed of this machine has been designed to stand the stresses induced by the cutting tool without vibration. The front ways of a lathe receive the greatest load from the cutting tool. The design of the machine has provided, in addition to the heavy double cross ties spaced every 24 in., an inclined solid web, which ties the front and back walls rigidly together and gives the front track a particularly strong support. The bed also has an unusually great depth and is supported on heavy cabinet legs. The inclined web also carries the chips through the holes in the back wall of the bed to the chip pan located at the rear of the machine, from which the chips may be easily removed.

The degree of accuracy which a lathe bed will maintain after it has been in service for some time is dependent on several important factors. The bearing pressure per square inch between the carriage and the bed should be as low as possible. The LeBlond type vee, which is used, has approximately twice the usual bearing area, which reduces the bearing pressure per unit of area between the carriage and the bed, and in consequence reduces the amount of wear produced. The bed is made of a special high steel mixture and cast so that a hard, close grained, uniform surface is obtained, which gives excellent, uniform wearing qualities. The ways are protected from being cut by steel chips by two sets of track wipers on the carriage, one ahead of the other, to prevent the scoring of the ways. The first wiper consists of a thin brass plate, which presses lightly against the track at an angle so that the chips are pushed off instead of being wedged under the wiper as in the ordinary construction. The second wiper consists of a heavy felt, which takes up any very small particles which may have slipped by the first wiper.

The old way of lubricating the carriage by merely applying oil to the way on either side of the carriage is not entirely satisfactory, because if the carriage is properly protected by track wipers, much of the oil is wiped off to waste and the oil does not get to the surface to be lubricated. This is particularly true when the work is short and the carriage covers most of the working distance. The oil is applied through covered oil cups directly to the working surfaces between the carriage track wipers, so that they help to keep the oil on the working surfaces instead of wiping it off. Oil grooves have been cut in the carriage for carrying the oil to the entire surface of the ways.



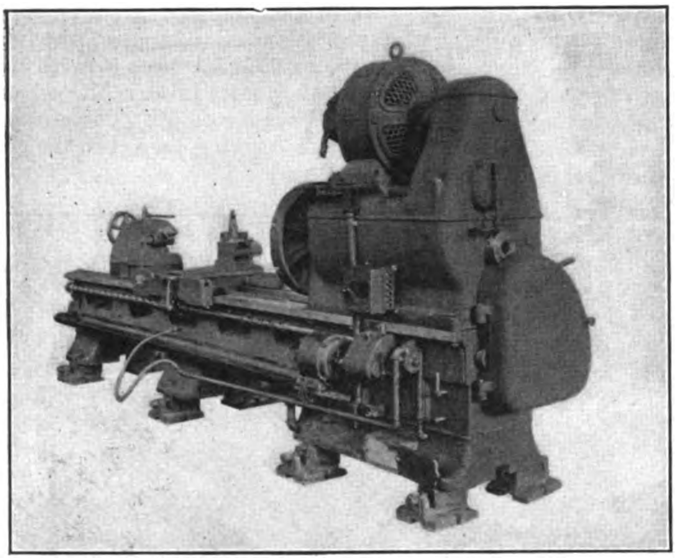
A Niles-Bement-Pond Heavy Duty Lathe Equipped with a "Jog" Push Button Which Controls the Face Plate

The machine is provided with a rapid power traverse. A separate motor drives a right and left hand screw at the back of the lathe through a gear box in which the gears run in oil. A right and left hand nut rotates on this screw ordinarily inside of a casing bolted to the carriage. When the rapid traverse lever at the front of the carriage is moved, it holds one or the other of the nuts stationary, depending on which direction the operator desires to move the carriage. It is very simple and is out of the way on the back of the lathe.

The apron is cast in one piece and designed so that all the gears have a double bearing. The gears are all of the Maag type and made of heat-treated steel, designed not only for strength but for securing the maximum amount of rolling and the minimum amount of sliding action. Instead of hav-

ing the usual friction feed, this machine has been provided with the positive fine tooth clutches so that the feed can be snapped in and out instantly. This is particularly important when it is desired to stop at a shoulder very accurately. Instead of having two levers, one for the cross feed and the other for the longitudinal feed, it is equipped with a single lever for operating both. Usually the operator will feed only in one direction, so that ordinarily he will need only the one lever for controlling his feed. By putting in most of the gears in the central section of the apron, coming under the rest, it has been possible to make the apron on each side so compact that the operator can get close to his work. Interlocks have been provided so that it is impossible for the operator to engage his lead screw nut while his power feed is on. The single lever for engaging both the longitudinal and the cross feeds also has been provided with a safetv trigger, so that it will be impossible for him to go from cross feed to longitudinal feed accidentally or vice versa. All the gears and the bearings on the apron are lubricated from an oil reservoir, so that the operator may oil the whole apron from a centralized point.

The machine is designed with a powerful drive in an oil-tight headstock. None of the gears are overhung. They are

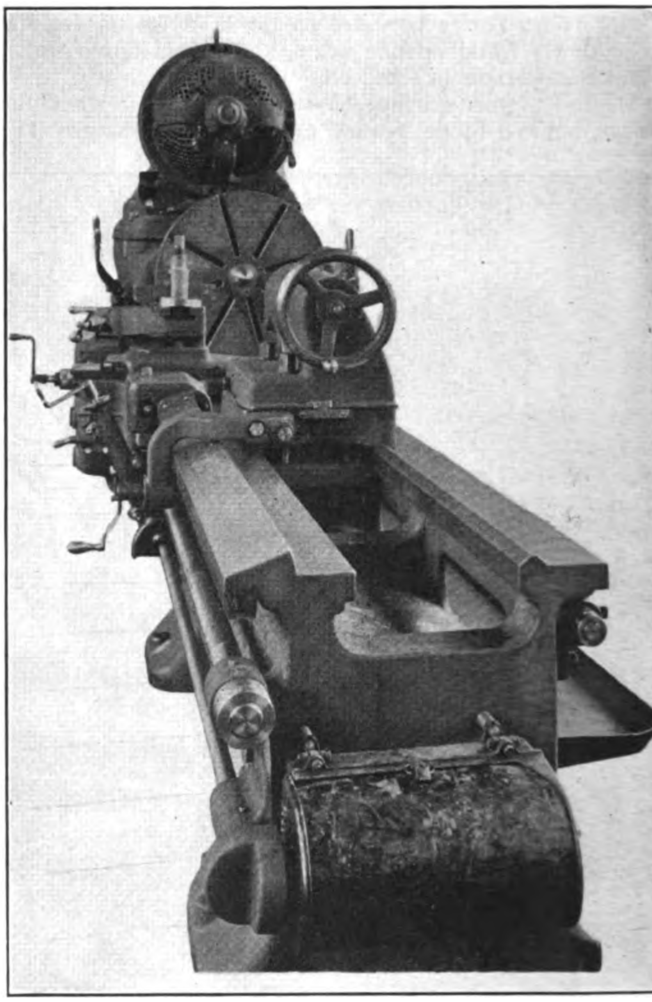


Back View Showing Rapid Traverse Screw and System of Lubrication

enclosed in a dust- and oil-tight head, and all the gears and bearings are flooded with filtered oil, pumped from the filter tank. The first driving pinion is mounted on its own shaft, with bearings on both sides, so that the motor bearings only carry the armature load instead of the loads induced by the belt and gear as in the other drives.

The d. c. and a. c. motor drive and the belt drive headstocks are all similar in structural principles of design, the only difference being that the a. c. and belt drive heads have more mechanical gear shifts. On the d. c. drive, full advantage is taken of the variable speed motor. The headstock is simplified, and the operator, through the control handle on the carriage, can easily vary the speed, so that it is seldom necessary to leave the carriage to shift gears. When the control handle on the carriage is moved to the "off position," the motor brings the faceplate quickly to rest through the dynamic brake circuit.

On other lathes it is necessary to provide a friction clutch to enable the operator to shift the gears into mesh for the different speeds. This lathe is provided with a "Jog" button control, so that when the button is pressed the gears turn over very slowly so that they may be easily shifted. As soon as the operator takes his finger off the button, the machine stops. This is also a very valuable feature on chucking work when the operator may wish to turn the faceplate through a small angle to adjust the paws. The operator may turn the faceplate through any angle by merely keeping his finger on the button the required length of time. The a. c. motor is direct-connected to the machine, since the need for the friction clutch has been eliminated by the "Jog" button. It may be instantly started or stopped from the control handle on the carriage by means of the automatic controller. A mechanical brake stops the machine instantly when the control handle is placed in the "off" position. If desired, a reversing controller can be furnished at a slight additional cost, so that the operator can also reverse the lathe from the carriage. The construction of the



End View Showing Extra Heavy Ribbed Sections and Sloping Bed Which Directs the Chips into the Chip Pan on Back of the Lathe

a. c. headstock is similar to the d. c. headstock, except that there are 12 speed changes instead of the four speed changes on the d. c. drive.

The single pulley is mounted between taper roller bearings which are adjustable for wear. The multiple disc clutch is of the type used on automobiles. The discs are engaged by springs, so that the pressure between the discs is not reduced as they wear and no adjustment is necessary to maintain the driving power of the clutch. A large number of steel discs are used, the alternate discs being faced with brake lining. Owing to the number and the size of the discs, the friction area is very large. The pressure between the discs is kept low and wear is reduced to a minimum. The clutch is operated from a handle on the carriage or from a lever below the head, which may be used when

shifting gears. When the clutch is released, a brake is automatically applied, stopping the machine at once. The clutch is operated through a ball thrust bearing. An extra wide driving belt with a high gear ratio gives abundance of power with a low belt tension. Twelve speeds are obtained by shifting gears.

The standard taper attachment travels with the carriage and is therefore always ready for use. The cross-slide is connected to the carriage for straight turning, and to the sliding block when turning tapers, the same bolt being used in each case so as to eliminate the possibility of connecting the taper attachment while the cross-slide is locked. The change from straight to taper turning is made by simply removing a bolt from one place and putting it in another, which may be done from the front of the machine. The long block, which slides in the taper bar, has large bearing surfaces. It is fitted with a taper gib, which is designed to receive and deliver pressure at the same height, which prevents any rocking and results in smooth and accurate work. The bolts which lock the taper bar can be reached from the front. The motion is transmitted through the cross-feed screw which, being of ample size to move the tool rest for straight turning, will move it with equal rigidity when turning tapers. The backlash in the screw is taken up by means of a compensating nut. The taper attachment does not cut down the swing over the bridge. Another advantage is that the cross-feed screw and taper attachment may be used at the same time.

A massive tailstock has been designed to carry heavy loads. It has a long bearing on the bed and is clamped to the bed by four locking bolts, all of which can be conveniently reached from the front of the machine. In the ordinary construction, the tailstock is split and the spindle clamped by drawing the split portion together. This throws the spindle out of alignment more or less and weakens the tailstock. On this tailstock the spindle is rigidly clamped by the double plug locking mechanism, which does not disturb the alignment of the spindle and permits a good bearing between the spindle and the tailstock. The spindle and self-ejecting center are made unusually large so that the heaviest loads can be supported rigidly. A large screw working in a long bearing makes it possible easily to feed the largest drills.

The quick change gear feed mechanism is mounted in a self-contained unit. A direct-reading feedplate has been provided so that the operator may select the desired feed immediately by placing the tumbler in the proper hole. The whole mechanism may be exposed by removing the top cover, making the gears readily accessible. The shafts are large in diameter with a relatively short distance between the supporting bearings.

All of the gears and bearings are continuously flooded with oil from the circulating oil supply furnished by the oil pump through the headstock. The oil from the feedbox overflows and drains into a tank in the bed, where it is filtered and again pumped back into the bearings. The cover on the feedbox projects well beyond the narrow tumbler slot and effectively protects the gears from dirt. The feed gears on the end of the bed are guarded by a strong cast-iron gear guard which is hinged to the bed. This construction is much better than having the type of guard which merely lifts off, since the operator is apt to remove the cover and forget to put it back on.

The lathe is provided with a coolant attachment. The pump for it is driven from the rapid traverse gearbox. It delivers the coolant to the flexible steel hose connected to the lathe carriage. The fluid, after cooling the tool, falls between the ways of the bed and drains through the holes in the back of the bed to the steel pan. From here it is drained to the head-end leg of the lathe, which forms a settling tank. This tank is divided into two compartments, the first compartment acting as a settling chamber for the small particles which pass through the screen. The overflow from this compartment goes to the second compartment from which the pump takes its suction. A clean-out door has been provided from which the sediment may be removed.

The Phee Journal Lubricating System

THE Phee system of journal lubrication, a recent development of the Froedtert Equipment Corporation, Milwaukee, Wis., is now being tested on three important mid-west roads and these tests promise to be of more than ordinary interest in view of the lubrication results obtained.

The construction and operation of the device are clearly shown in the drawing, Fig. 1 and the photograph, Fig. 2. A metal plate resting on the bottom of the journal box supports the upper portion of the device by means of six springs. The upper portion consists of two metal plates supporting three layers of wool felt, 3/8 in. thick. The bottom layer of felt projects at each end sufficiently to drop down to the bottom of the box, and two additional strips of felt project downward to the bottom of the box through the center of the metal plates. The top two layers of felt are 1 in. shorter than the journal bearing surface to allow for lateral movement. Thus the layers of felt when in position are held in contact with the bearing surface by means of the springs. In addition to this, the brass, which is the standard brass now used, has a series of holes 3/8 in. in diameter and 5/8 in. in

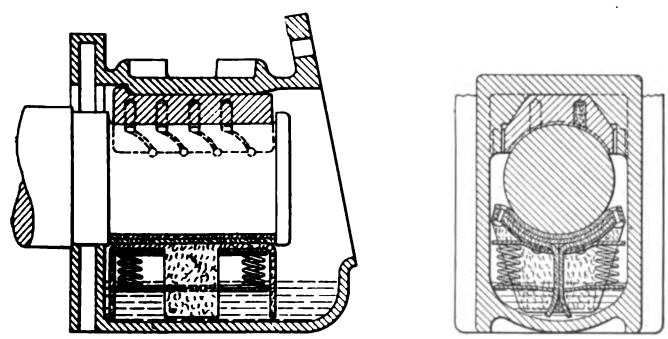


Fig. 1—Sectional Drawing of the Journal and Lubricating Device

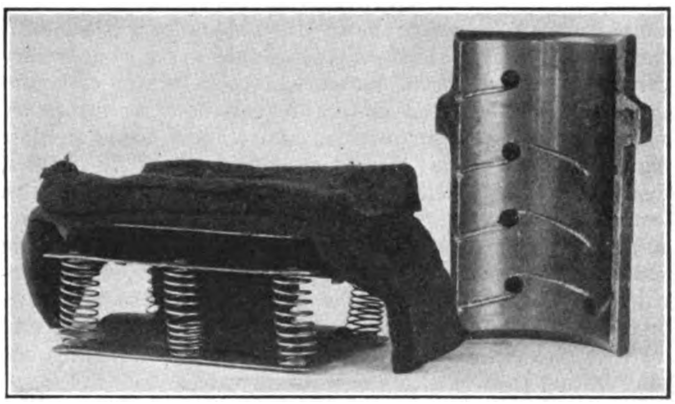


Fig. 2—The Brass Has a Series of Holes Connected by Channels

depth, drilled along each side, connected by channels ⅛ in. in depth as shown in Fig. 2.

The installation of this device is said to require no alteration in the construction of the standard journal box as now used. It is simply inserted in place of the oil saturated waste. Before inserting, the spring and felt devices are thoroughly saturated with oil, the same oil now employed being used in conjunction with this method. About two quarts of free oil are added to the box after placing the spring and felt devices in position.

The action of the Phee system in supplying oil to the journal is as follows: Oil is fed to the bearing surface by means of the pad which is in contact with the journal, additional oil being fed as required to the pad by means of the four wicks which rest in the free oil in the bottom of the box. These wicks have a threefold action: They feed oil to the pad, filter the oil as it passes up, and act as a guard at each end, preventing foreign matter from coming in contact with the bearing surface. The purpose of grooving and drilling the brass is mainly to insure a plentiful supply of free oil to the bearing surface during the time required to allow the brass to be worn to a perfect bearing seat.

The following results are reported of a test of 12 of these devices applied March 1, 1924, to a car in passenger service making a run of 190 miles a day. The journals on this car are 4¼ in. by 8 in. in size. On April 1 this car was inspected after a total run of 5,980 miles and the spring and felt devices were in excellent condition, the felt showing only slight signs of wear; the running temperature of the journals was lower than on those lubricated by waste and oil, and there was no indication of hot journals. On May 3 this car had made a total run of 11,970 miles with no attention whatever. No additional oil had been added since installing the devices and apparently the car was in condition to run several thousand miles further before it would be necessary to add additional oil. One of the boxes on this car was defective to such extent that it would not hold oil, and the car ran over 5,000 miles with no free oil in the box, sufficient oil being contained in the felt pad to lubricate the journal properly.

The tests up to the present time apparently indicate that a considerable saving in oil and labor can be effected by the use of this method of lubrication. One of the greatest claims, however, is that this system will eliminate the trouble experienced at the present time due to hot boxes, the actual cost of which, while very difficult to estimate in dollars and cents, is of considerable extent when the delay to the train, loss of revenue by setting out the car, labor, loss of material due to destruction of the journal, brass, waste and oil are all considered.

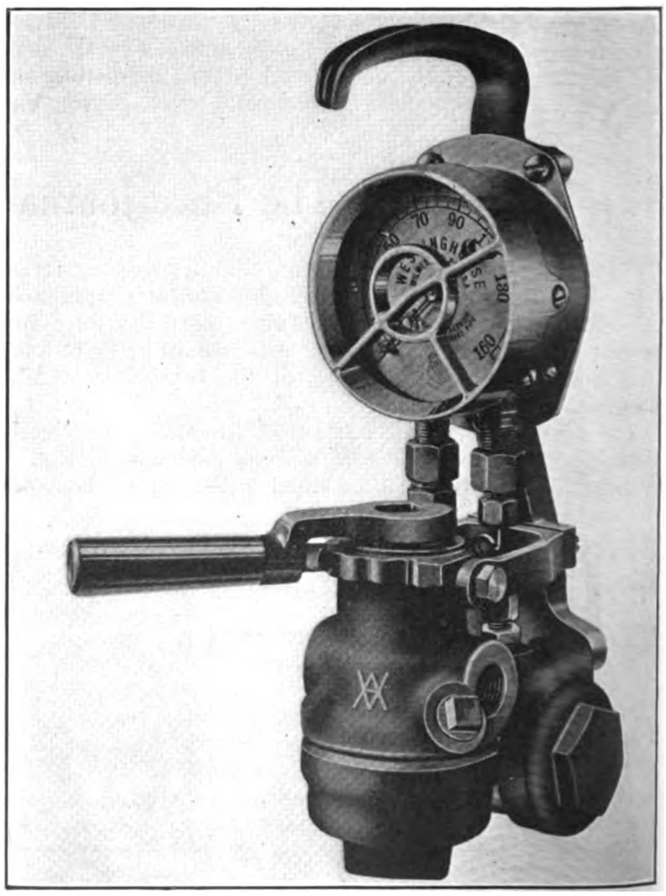
Single Car Testing Device

THE single car testing device illustrated is a recent development made by the Westinghouse Air Brake Company, Wilmerding, Pa., to meet the demand of certain railroads for a device to test the brake on a single car, which design displaces those devices used by many roads, made up of pipe fittings, cut-out cocks and choke fittings. This device is not designed for the purpose of testing triple valves, as it is not the intention to displace in any manner the A. R. A. requirements with respect to triple valve testing on the standard A. R. A. rack.

When a car is on the repair track the brake should be tested, regardless of the last cleaning date, before the car is allowed to go into service, and it is for the purpose of facilitating this test of the general condition of the brake on a single car that the new testing device was designed.

The following advantages as compared to the old style testing device will be apparent from the illustration: It is more compact, therefore more easily handled; it contains one duplex gage instead of two single gages; one rotary valve takes the place of the cut-out cocks, drain cock and chokes which were used in the previous designs; the rotary valve is more easily maintained and simpler to manipulate than the cut-out cocks; the device has a curled hair strainer, easily accessible for cleaning, which protects the rotary valve from dirt and wear; the design is such that the device may be put on the ground in an upright position and is therefore less liable to damage. A handy means of carrying is provided in the handle above the gage, which also acts as a protection to the gage; the rotary valve seats upward and there is no need of a stem gasket, thereby eliminating one contributing cause to a hard working valve.

The operating handle has six working positions. The first position, at the extreme left, is for the purpose of quickly charging the brake pipe and the auxiliary reservoir. The second position admits pressure to the brake pipe at a pre-determined rate and is used to release the brake, after the proper brake application has been made, and determine if the brake is in condition for further service. If the brake does not release under this test, necessary repairs must be made. The third position is lap, in which position all ports are closed. The fourth position is slow application. Should the brake fail to apply during this application, proper repairs must be made before the car is put in service. The



Westinghouse Single Car Testing Device Which Displaces Pipe Fittings, Cut-Out Cocks and Choke Fittings

fifth and sixth positions are for the purpose of determining the stability of the brake in regard to emergency. In the

fifth position emergency should not occur and in the sixth position emergency should take place.

Different sizes of ports in the rotary are necessary for freight and passenger service. The reason is that this device is for testing the brake on a single car; therefore, the volumes on the particular type of car to be tested must be given consideration, and as a passenger car is approximately twice the length of an average freight car, it is necessary to so arrange that the same results are obtained in both cases. These devices are assembled for either freight or passenger service before leaving the factory, and the service for which they are intended is indicated on the name plate. They are so designed that they can be connected to the yard charging line and to the brake pipe on the car.

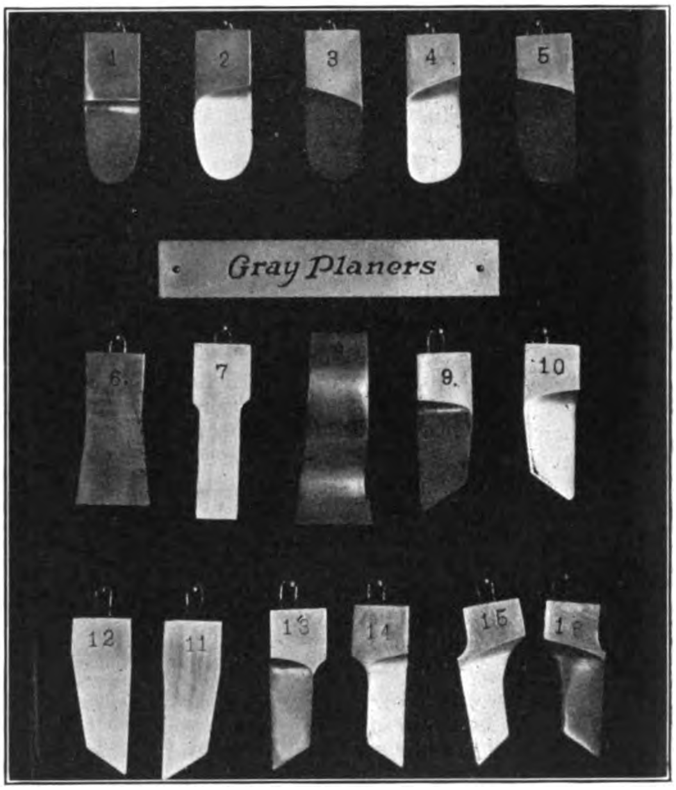
Standardized Planer Tools

It is a matter of common knowledge that getting the right angle and shape for a planer tool makes a big difference in the results obtained with the tool. The roughing tool that is right for steel will have too keen an edge for cast iron and will tend to dig in, leading to chatter. The first instinct of the operator is to cut down the amount of feed, thereby decreasing production.

There are, of course, certain elementary principles that every planer operator and certainly every foreman should fully understand. The tool ought not to reach beyond the bottom edge of the apron any more than is absolutely necessary, and should be made from heavy stock, so as to minimize springing under the pressure of cutting. At the same time, the right shapes and angles are often a matter of debate, because very few workmen have time to carry through the necessary experiments to establish these shapes and angles, and they certainly must be established by the old-fashioned method of "cut and try."

The G. A. Gray Company, of Cincinnati, Ohio, has recognized this difficulty and has brought out a chart, entitled "Cutting Tools Recommended for Use on Gray Planers." This gives the proper shape as well as the angles of rake and clearances on a set of sixteen general purpose tools, together with sketches showing the use for which the tool is intended.

To supplement the chart, the Gray company furnishes aluminum models, which are numbered to correspond with the chart, and have the various surfaces accurately ground. These can be handed to a blacksmith, who, although he cannot read a drawing, will, in forging a tool, imitate the model so that it can be quickly ground to shape. The set of 16 model tools is mounted on a neat wall board.



G. A. Gray Tool Board Displaying 16 Aluminum Model Tools

Hanaford Angle Cock

The Car Devices Company, Inc., Richmond, Va., have recently added to the line of railway devices an angle cock with a rear extension on the body cast in one piece. The object aimed at in designing this device was to produce an angle cock which would take the place of the old style two or more part malleable iron angle cock holder. This was effected by adding to the body a symmetrical rear extension. A bracket can be applied above or below the brake pipe and riveted to the end sill, or on the side and riveted direct to the striking casting. Best results are obtained by using a 3/8-in. by 4 1/2-in. open hearth steel bracket.

Angle Cock With Rear Extension Cast on the Body

The threads and the end of the nipple on the train line are completely enclosed by the rear extension. This reduces to a minimum loss due to the train pipe nipple breaking through the threads at the angle cock.

Reclaiming Splice Bar Machine—Correction

The June 18 issue of the Daily Railway Age contained a description of a splice bar reclaiming machine manufactured by the Rockford Milling Machine Company, Rockford, Ill. In the last sentence of the article it was stated that the weight of the machine was approximately 1,200 lb., which is an error. The correct weight is between 11,000 lb. and 12,000 lb.

GENERAL NEWS

Electric lights are required in the marker and classification lamps of locomotives in Canada by an order issued by the Board of Railway Commissioners on June 6. The order applies to all new engines that have electric light installations, and to all locomotives after December 31, 1925. This order is made on the basis of a hearing held last February, in which the brotherhoods claimed that oil lamps were not reliable and usually were not well maintained.

The New York State law requiring 24-ft. cabooses and regulating the construction of cabooses, the non-use of small coal cars, etc., is now in effect. The provisions of this law, which originally were put on the statute books in 1913, were later subjected to modifications, postponing the date when they should be enforced, but the last of these modifications has now become of no effect. It appears that substantially all of the railroads affected by the law have complied with its provisions long since.

Big Four Resumes Operation of Shops

The Cleveland, Cincinnati, Chicago & St. Louis has canceled its contract with the Railway Service & Supply Corporation under which that corporation has operated the shops of the railroad at Beech Grove, Ind., during the past two years and is now operating the shops directly. The number of employees now at work is about 900. To those men who were employees of the company under former conditions and who joined the strike of 1922, the road has made an offer to restore seniority rights, under certain conditions, which offer remains good for about one month.

Inspection Bureau Finds 46.9 Per Cent of Locomotives Defective

The Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment shows 5,675 locomotives inspected by the Bureau of Locomotive Inspection during the month of June, of which 2,662 or 46.9 per cent, were found defective and 279 were ordered out of service. The Bureau of Safety inspected 99,722 freight cars, of which 4,207 were found defective, and 1,612 passenger cars, of which 67 were found defective. During the month 18 cases, involving 124 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Failure of Conspiracy Suit Against the Pennsylvania

The United States Circuit Court of Appeals, at Philadelphia, July 14, dismissed the equity suit brought against the Pennsylvania Railroad by the System Federation of Shop Craftsmen and the Clerks' brotherhood to enforce increases in wages which, as claimed by plaintiff, ought to have been made in compliance with a decision which had been made by the Railroad Labor Board, calling for the continuance of rates of wages which had been paid by the U. S. Railroad administration. The sum named, $15,000,000, was the estimated difference between what the employees have received from the railroad company and what they would have received under the higher rates claimed. The present decision sustains that of the district court, handed down several months ago. Representatives of the shop crafts declare that the case will be appealed to the Supreme Court of the United States.

Wage Statistics for April

The summary of wage statistics for the month of April, 1924, issued by the Interstate Commerce Commission, shows a total of 1,787,217 employees, an increase of 26,949, or 1.5 per cent, over the number reported to March, 1924. Owing to seasonal requirements, an increase of 49,849 employees appears in the maintenance of way group, but this number was offset somewhat by reductions in the maintenance of equipment, and the transportation groups. Notwithstanding an increase of 1.7 cents per hour in the straight time wages of train and engine service employees, which is perhaps the reflection of recent wage adjustments, the average hourly earnings of all employees, owing to an increase in the number of lower paid employees and a reduction in the number of the higher paid employees reported on an hourly basis, shows a decrease of 4 mills per hour. There was also a decrease in the quantity of overtime work and in the average overtime rate per hour. The total compensation in April was 1.9 per cent less than in March. Compared with the returns for the corresponding month last year, the employment in April, 1924, decreased 3.1 per cent and the total compensation shows a decrease of 3.6 per cent.

Cars and Locomotives Placed in Service

Class I railroads during the first six months this year installed in service 70,874 freight cars, according to reports filed by the carriers with the Car Service Division of the American Railway Association. This was a decrease of 8,366 cars as compared with the number installed during the corresponding period in 1923. The railroads on July 1, 1924, had on order 60,315 freight cars as compared with 96,855 on July 1, 1923, or a decrease of 36,540.

The railroads during the first half of 1924 also installed 1,071 locomotives, as compared with 1,998 during the corresponding period the year before, or a decrease of 927. They also had on order on July 1, 360 locomotives, as compared with 1,902 last year.

Of the cars placed in service 12,319 were installed during the month of June, including 4,607 box cars, 3,653 coal cars and 1,976 refrigerator cars, including those installed by railroad owned private refrigerator companies. The railroads also placed in service during the month 160 locomotives. These figures as to freight cars and locomotives placed in service or on order include new, rebuilt and leased equipment.

Progress in Application of B. & O. Shop Plan on C. N. R.

A survey of the main shop points on the Canadian National has been begun, starting with the Winnipeg shops, preparatory to the experimental application of the co-operative shop work plan, known as the Baltimore & Ohio co-operative plan, to the Canadian National Railway System. The plan aims at co-operation between the employees of the shops and the management in the working of the shops with a view to less waste and better production; a voice in shop management for the men; and a share for the employees in the benefits accruing from co-operation. It was endorsed by the convention of Division 4, Railway Employees' Department, of the American Federation of Labor representing all railway shop crafts in Canada. It has also received the approval of Sir Henry Thornton, president of the C. N. R. Following the Division 4 conference B. M. Jewell, president of the Railway Employees' Department of the A. F. of L.; William H. Johnston, president of the International Association of Machinists, and father of the co-operative shop plan; and Capt. O. S. Beyer, Jr., consulting engineer for the shopmen, and representatives of the shop crafts of the system, met Sir Henry Thornton.

Reporting on this conference to officials of Division 4 Mr. Jewell stated, "Sir Henry Thornton said he was convinced that this was the most important gesture that has been made in the industrial world in years and that it has within it the germs of the solution of all our industrial problems. He was prepared to co-operate fully in order to make the experiment a success." After the survey of the Winnipeg shops it was stated at the offices of Division 4 in Montreal that a survey of all the shops in Eastern Canada would be made. A joint report will then be made to Sir Henry by Capt. Beyer and the international unions. The shop for the experiment in co-operation has not yet been selected, but the selection will be made by the shop crafts with the assent of the employees and the management.

C. N. R. Officers Offer to Accept Pay Reduction While Shops Work Part Time

A co-operative plan for assisting the finances of the Canadian National is now in consideration at the headquarters in Montreal. The board of directors has received an offer from the officers of the system, including vice-presidents, general managers, superintendents and heads of all departments and every officer above the grade of chief clerk to have their salaries reduced one day's pay per month during the five-month period of curtailed receipts. If accepted by the board it is stated that the offer would apply only to the period during which a reduction in working hours in the shops of the system is in effect. In the case of Sir Henry Thornton, the president, whose salary is $50,000 a year, the reduction would mean about $1,600.

At the end of June the employees at the Canadian National shops at Point St. Charles (Montreal), St. Malo (Quebec City), Leaside (Toronto), Stratford (Ontario) and London (Ontario) were offered the alternative of a reduction in working hours or a reduction in force. The representatives of the men stated that they would not accept a reduction in working hours under their scheduled agreement with the company, consequently an order was given for the staffs to be reduced on July 1. Then the men from London and Point St. Charles asked the company to reopen the question and they decided they would accept a reduction in working hours to three weeks a month. Leaside and St. Malo did not come to any decision and steps were taken to reduce the staff. The acceptance by Point St. Charles, Stratford and London was for the month of July only, and the men are now taking a canvass as to the ensuing five months. Since then Leaside and St. Malo have asked to go under the scheme of reduction of working hours.

Railroad Wages Hold Their Lead Over Those in Other Industries

Railroad wages continue to lead those of manufacturing industries, according to the National Industrial Conference Board, New York City, which has recently investigated the trends of wages, hours and employment of railway labor as a whole from the 1914 period to the end of the first quarter of this year. In the first quarter of 1924, the average hourly earnings of all railroad wage earners were 60 cents, which is 13 per cent greater than the hourly earnings in 1914, and 10 cents below the highest peak of 1920. The purchasing power of the weekly earnings of these employees in the first quarter of 1924 was 30 per cent greater than in 1914, showing a slight increase since the second half of 1923. This condition is due to a slight increase in earnings and a slight decrease in the cost of living.

These figures are based on the average number of wage earners on those railroads whose annual revenues total one million dollars a year or over. During the first quarter of 1924, the number of wage earners stood at 1,249,873.

The board made a comparison between the trends of wages for skilled labor in foundries and machine shops and that of skilled shop labor on the railroads. In 1914, the average hourly earnings of both were nearly equal, but by 1920 the railroad group had advanced far ahead. In the first quarter of 1924 the earnings of skilled labor in foundries and machine shops were 108 per cent greater than in 1914, but the railroad skilled shop labor at the end of last year were earning 142 per cent above the 1914 to 1915 level and advanced still further to 72.2 cents per hour in the first quarter of this year. The board's report discusses in detail the rates of wages of railroad workers in relation to their different classes of employment and in relation to the cost of living. Incidentally, it shows the hourly earnings of unskilled railroad workers were 130 per cent greater at the end of the first quarter of 1924 than in 1914. It shows also that practically all increases and reductions in railroad wages since the termination of federal control were based on the rulings established by the United States Railroad Administration, and that the wages of the train and engine service employees, therefore, have never risen relatively so high as the wages of other classes of railroad labor.

In general, the board states that railroad labor as a whole and two of its principal sub-divisions—skilled shop and unskilled labor—were materially better off early in 1924 than in 1914. It is also shown that the average working week per employee was considerably shorter and the purchasing power of weekly earnings substantially greater. The position of the train and engine service employees, however, was not so advantageous as that of other classes of railroad labor or of railroad labor regarded as a whole.

MEETINGS AND CONVENTIONS

Third National Exposition of Power and Mechanical Engineering

Over 260 exhibitors have been assigned space at the third national exposition of Power and Mechanical Engineering which will be held in the Grand Central Palace, New York, December 1 to December 6, inclusive. The exposition will, as usual, parallel the meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers. The A. S. M. E. meeting will be held in the Engineering Societies' build-

LOCOMOTIVES ORDERED, INSTALLED AND RETIRED

Month	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. Shops
September	384	22,342,517	260	7,191,302	64,720	2,506,469,051	7
October	408	21,665,487	301	7,935,709	64,827	2,520,200,846	15
November	333	19,054,713	282	7,741,395	64,879	2,532,085,380	14
December	333	18,260,423	316	8,738,378	64,896	2,541,607,425	14
Full year 1923	4037*	....	3672	....	.....	....	..
1924							
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	...	....	...	....	.....	....	..
Total for 5 months	911	....	...	....	.....	....	..
Total for 6 months	701	....	...	....	.....	....	..

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

* Corrected figure.

FREIGHT CAR REPAIR SITUATION

Date, 1923	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	2,270,405	116,697	38,929	155,626	6.8
1924					
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1
March 1	2,262,254	119,505	49,277	168,782	7.5
April 1	2,274,750	125,932	46,815	172,747	7.6
May 1	2,271,638	131,609	47,666	179,275	7.9
June 1	2,280,295	138,536	50,683	189,219	8.3

Month	Cars repaired: Heavy	Light	Total
June	121,077	2,451,758	2,572,835
September	114,064	2,335,161	2,449,225
October	117,254	2,444,118	2,561,372
November	104,761	2,214,617	2,319,378
December	87,758	2,073,280	2,161,038
January	76,704	2,083,583	2,160,287
February	70,056	2,134,781	2,204,837
March	77,365	2,213,158	2,290,523
April	75,352	2,074,629	2,149,981
May	73,646	2,130,284	2,203,930

ing, 29 West Thirty-ninth street, New York, and the A. S. R. E. meeting will be held in the Hotel Astor, New York. Plans are under way for the American Society of Heating and Ventilating Engineers to have a gathering of local sections during the time of the exposition.

Railway Technical Congress in Berlin

The Association of German Engineers (Verein Deutscher Ingenieure) in close association with the German State Railways will hold a railway technical congress in Berlin on September 22-27 for the discussion of engineering, mechanical and electrical problems and developments. Extensive exhibits of rolling stock and appliances will be on view. Further details may be obtained by addressing the Verein Deutscher Ingenieure. (Abt. E. T.) Sommerstrasse 4a, Berlin, N. W. 7, Germany.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railroad Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention September 3, 4 and 5, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September 16, 17, 18 and 19.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Truscon Steel Company has moved its Chicago office to 165 E. Erie street.

A. W. Dorsch, field superintendent of S. F. Bowser & Co., with headquarters at Ft. Wayne, Ind., has resigned to engage in other work.

The Barco Manufacturing Company of Canada has moved into larger space in the Tower building, Devonshire Road, Walkerville, Ont.

John W. Fogg, general sales manager of the Boss Nut division of the American Bolt Corporation, has been promoted to assistant to the vice-president.

The Gibb Instrument Company, Bay City, Mich., has placed W. F. Hebard & Company, 551 W. Van Buren street, Chicago, in charge of its office in that city.

F. M. English, who has been in the service of the Reading Iron Company, Reading, Pa., since 1919, has been appointed assistant sales manager to succeed A. F. McClintock, resigned.

B. W. Beyer, Jr., sales engineer of the Union Special Machine Company, Chicago, has been appointed district sales engineer of the Industrial Works, Bay City, Mich., with headquarters at New York.

The Thermal Efficiency Company, Scarritt building, Kansas City, Mo., has been appointed district representative in western Missouri and Kansas for the Conveyors Corporation of America, Chicago.

J. W. Selzer, representative of the M. L. Shepard Lumber Company, with headquarters at Chicago, has been appointed representative of J. E. Morris Company, Chicago, with headquarters at Chicago.

C. A. Fisher has been appointed district representative of the Central Iron & Steel Company, Pittsburgh, Pa., with offices at 303 Keystone building, Houston, Tex., and 1918 W. T. Wagoner building, Fort Worth.

The Grip Nut Company, Chicago, has acquired a tract of land at 5917 S. Western avenue, on which it will lay out an 18-hole practice golf course covering two acres, which may be used by employees and visitors to the factory.

J. V. Miller has resigned as district storekeeper of the Chicago, Milwaukee & St. Paul at Deer Lodge, Montana, to become western sales representative of the Prime Manufacturing Company, with headquarters at Milwaukee, Wis.

Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and a well-known electrical genius and inventor, died on July 8 at East Liberty, Pa., after an illness of several months.

The Northern Refrigerator Car Company, Cudahy, Wis., has given a general contract to the Worden-Allen Company, Milwaukee, Wis., for the construction of a one-story brick and steel car construction and service shop, 125 ft. by 225 ft.

D. R. Arnold, general sales manager of the Canadian Car & Foundry Company, Ltd., with headquarters at Montreal, Que., has been appointed assistant to the vice-president of the Union Metal Products Company, with headquarters at Chicago.

W. M. Ryan, of Chicago, Ill., formerly president of the Ryan Car Company, has been elected president and a member of the board of directors of the Youngstown Steel Car Company, Niles, Ohio. Mr. Ryan succeeds William Wilkoff, who remains a member of the board of directors, but who is retiring from active business duties.

The Smith-Heylandt Company has been organized with a working capital of $500,000 and offices at 2633 Fourth street S. E., Minneapolis, Minn. This company will take over the patents, importation, sale and distribution of the Heylandt apparatus for the manufacture of oxygen and other gases by the liquefaction process. E. H. Smith, president of Smith's Inventions, Incorporated, and the Commercial Gas Company, Minneapolis, is president of the new organization; J. R. R. Miles is secretary.

H. A. Irwin, far east representative of the Landis Machine Company, the Landis Tool Company, the Warner & Swasey Company, and the Kearney & Trecker Company, died in Tokio, Japan, on June 22. Mr. Irwin was for a number of years direct representative of the Landis Tool Company in Europe. About four years ago he became connected with the four companies by whom he was employed at the time of his death.

The Bassick-Alemite Corporation, Chicago, has purchased the Allyne-Zerk Company, Cleveland, O., manufacturer of high pressure lubricating systems, and will operate it as an independent unit but under the same general management as the other seven companies controlled by the corporation. E. W. Bassick, president of the corporation, is chairman of the executive committee which directs the corporation. E. S. Evans, president of E. S. Evans & Co., Detroit, has been made vice-president and general sales manager of the corporation and will have charge of the sales of all the units.

William S. Boyce has been promoted to assistant to the president of the Railroad Supply Company, Chicago, in charge of sales. Mr. Boyce was born in Del Rio, Tex. He graduated from the Agricultural and Mining College of Texas with the degree of civil engineer, and entered the maintenance department of the National Railways of Mexico immediately following. In 1909 he returned to the United States to enter the employ of the Chicago Great Western in the maintenance of way department in the office of the general manager and later was appointed roadmaster. Later he resigned to enter the employ of the Atchison, Topeka & Santa Fe as a roadmaster and in 1911 he entered the railway supply field. In 1923 he became associated with the Railroad Supply Company as a special representative, with headquarters at Chicago, which position he has held until his recent appointment.

Official announcement has been made that the British government, through the Surplus Stores and Liquidation Department in London, has accepted the tender of the Montreal firm of Hope E. Scott & Company, Ltd., on approximately 47,000 tons of unassembled freight car materials which were manufactured during the war by Canadian car builders, including the Canadian Car & Foundry Company and the Eastern Car Company, for the Russian government. Through the failure of the Russian government to take delivery of the cars at the time, the materials have been lying in storage at different points in Canada since 1917, but principally at Vancouver. It is the intention of the Scott firm to rebuild the cars for export to Japan. The transaction involves the reconditioning of approximately 4,000 cars. The re-sale value of the cars after reconditioning will be about $6,000,000. Work will begin on them in about a month.

Cleon M. Hannaford on July 1, severed his connections with the Chesapeake & Ohio and will devote his entire time in future to the railway supply business as president of the Car Devices Company, Inc., Richmond, Va., which he organized in 1922 and to the development of a number of patented devices invented by him. Mr. Hannaford entered the service of the Boston & Albany in 1912 as blue print operator, he subsequently was promoted to tracer in the mechanical department, and later served as draftsman until 1916 when he was appointed draftsman in the West Springfield shops in charge of stationary and operating tests. In January, 1917, he left the service of the Boston & Albany to go to the Chesapeake & Ohio as assistant chief draftsman in the motive power department at Richmond, Va., where he was in charge of designing freight cars and locomotives and of preparing drawings and specifications for new equipment. His inventions include a lock lift; forged steel uncoupling attachment; one-piece drop forged angle cock holder; and an angle cock with rear extension.

C. M. Hannaford

TRADE PUBLICATIONS

Pipe Hangers.—An 8-page bulletin, No. 2058, descriptive of Wedgtite pipe hangers, has been issued by the Crouse-Hinds Company, Syracuse, N. Y.

Walworth Log.—The Walworth Manufacturing Company, Boston, Mass., is preparing in booklet form an interesting log of its new branch office at Buffalo, N. Y.

Speed Meters.—A four-page bulletin, No. 624, descriptive of multiple speed meters for power plants has been issued by the Esterline-Angus Company, Indianapolis, Ind.

Connectors.—Male, female and flanged connectors of the CG series are briefly described in an illustrated folder recently issued by the Crouse-Hinds Company, Syracuse, N. Y.

Waterproofing.—Service Bulletin No. 6A briefly describing Karnak waterproofing and listing a number of Karnak publications, has been issued by Gardiner & Lewis, Inc., New York.

Electric Blowers.—Specifications for variable speed electric blowers with new enclosed regulators are given in a bulletin recently issued by the Buffalo Forge Company, Buffalo, N. Y.

Journal Box Lids.—The Allegheny Steel Company, Brackenridge, Pa., has recently issued a four-page bulletin, which is the first of a series to be published illustrating its self-fitting torsion spring A. R. A. standard journal box lid.

Oxy-Acetylene Equipment.—Oxy-Acetylene equipment for welding, cutting, brazing, lead burning, heating and decarbonizing is fully described and illustrated in a 48-page brochure recently issued by the Oxweld Acetylene Company, Long Island City, N. Y.

Engineering Data.—Considerable engineering data regarding the Maxi-mill in railroad work, the Bullard driving box borer and facer and the vertical turret lathe is contained in a loose-leaf booklet recently issued by the Bullard Machine Tool Company, Bridgeport, Conn.

Reamers.—Catalog No. 5 recently issued by the Wayne Tool Manufacturing Company, Waynesboro, Pa., contains in 20 pages a description of the complete line of Wayne bridge reamers, high speed steel counter-sunks and the Wayne drill chuck for salvaging broken twist drills.

Mechanical Painting.—The MetaLayer Schoop process of mechanical painting as it has been developed and perfected for application to any commercial metals, either in wire or dust form, is fully described in a 16-page, illustrated pamphlet just issued by the Metals Coating Company of America, Philadelphia, Pa.

Power Transmission.—A complete text book on power transmission (silent chain transmission in particular) has just been issued by the Ramsey Chain Company, Albany, N. Y. It is a 48-page illustrated book in two colors, and treats on the comparisons between the various methods of drives, leather and rubber belting, gearing, direct drives, and silent chain. It also covers the transmission problems in various fields, and contains complete engineering information and data for laying out silent chain drives.

Locomotive Feed Water Heaters.—Detailed instructions covering the inspection, testing, cleaning and repair of the Elesco feed water heater are given in the second edition of an instruction book recently issued by the Superheater Company, New York. The principle of operation of the superheater also is described and, by means of two colored charts, the passage of steam and water through the equipment is shown. An added feature of this edition of the instruction book is an order list covering feed water heater parts.

Manganese Steel Castings.—The American Manganese Steel Company has issued catalog No. 3 describing and illustrating manganese steel castings used in contractors' equipment. Under this heading is included: Complete dippers for steam shovels, teeth and other parts of such dippers, dredge buckets, wearing parts for gyratory, jaw and roll crushers, screens for quarry and mine operations, conveyor and power chains, elevating buckets, sprockets, gears and pinions. Unusual pains have been taken to present the matter in a lucid form and a large number of illustrations have been used.

PERSONAL MENTION

General

William O. Forman, assistant mechanical superintendent, with headquarters at Boston, has been promoted to mechanical superintendent, with the same headquarters, succeeding C. H. Wiggin.

Charles H. Wiggin, mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., who had completed 42 years of service with the company on July 1, and having requested that he be assigned to less arduous duties, has accordingly been appointed consulting mechanical engineer, with the same headquarters.

Edwin B. De Vilbiss, whose promotion to superintendent of motive power of the Central Pennsylvania division, Eastern region of the Pennsylvania, with headquarters at Williamsport, Pa., was announced in the July *Railway Mechanical Engineer*, was born on September 13, 1884, at Ft. Wayne, Ind., and was graduated from Purdue University in 1908. He entered railway service on July 1 of the same year as special apprentice of the Pennsylvania in the Ft. Wayne shops and in January, 1911, he was promoted to motive power inspector. On April 1, 1912, he became electrical engineer of the Northwest system and on June 1, 1915, he was appointed assistant engineer of motive power of the Central system. He was appointed assistant engineer of motive power in the office of the general superintendent of motive power on October 15, 1917, and on March 1, 1920, Mr. De Vilbiss was promoted to superintendent of motive power of the Eastern Ohio division, with headquarters at Pittsburgh, Pa. A year later he became master mechanic of the Eastern division, with headquarters at Canton, Ohio, the position he held at the time of his recent promotion to superintendent of motive power.

Car Department

J. T. St. Clair has been promoted to engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, succeeding E. Posson who has retired. Mr. St. Clair was born in Michigan and graduated from the Engineering department of the University of Michigan, with degrees in both mechanical and electrical engineering. He entered the employ of the American Car & Foundry Company in 1899, and after several years in their shops, was promoted to consulting engineer, with headquarters at St. Louis, Mo. In addition to his duties in connection with the design and construction of cars, Mr. St. Clair was also engaged in the lay-out of car shops and their equipment and the testing of machinery installed. During the war he was a captain in the Engineering division of the Ordnance department in charge of the design and construction of railway mounts for heavy artillery. Mr. St. Clair entered railway service in 1923 as acting engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, and he remained in that position until his recent promotion to engineer of car construction.

J. T. St. Clair

Edward T. Millar, who has been on leave of absence on account of illness, has resumed his duties as general car inspector of the Boston & Maine, with headquarters at Boston, Mass.

S. P. Alquist, master car builder of the Pere Marquette, has been appointed to a similar position on the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., succeeding J. C. Fritts, resigned.

Master Mechanics and Road Foreman

G. S. West, general foreman of the Cumberland Valley division of the Pennsylvania, has been appointed assistant master mechanic of the Meadow shops, New York division, succeeding J. A. Sheedy, promoted.

Shop and Enginehouse

D. K. Chase, motive power inspector of the Meadow shops, New York division, of the Pennsylvania, has been appointed general foreman of the Cumberland Valley division, succeeding G. S. West.

P. A. Carter, foreman of the Chouteau avenue shops of the St. Louis-San Francisco at St. Louis, Mo., has been promoted to roundhouse foreman of the new shops at Lindenwood, a suburb of St. Louis.

W. J. Ficke, formerly night general foreman of the North Side shops of the St. Louis-San Francisco, at Springfield, Mo., has been promoted to general foreman of the new shops at Lindenwood, a suburb of St. Louis, Mo.

Purchasing and Stores

Frank T. Swain has been appointed assistant purchasing agent of the Lehigh & New England.

L. Crassweller, assistant purchasing agent of the Northern Pacific, with headquarters at Seattle, Wash., has been transferred to St. Paul., Minn.

Paul McKay has been appointed assistant purchasing agent of the Northern Pacific with headquarters at Seattle, Washington, succeeding L. Crassweller.

Ed Hoffman, assistant purchasing agent of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has been promoted to general purchasing agent, succeeding J. D. McCarthy, resigned.

W. B. Gordon, district storekeeper of the Canadian National with headquarters at Montreal, has been promoted to assistant general storekeeper, with headquarters at Toronto, Ont., succeeding Mr. Toye.

E. D. Toye, assistant general storekeeper of the Central region of the Canadian National, with headquarters at Toronto, Ont., has been promoted to general storekeeper, with the same headquarters, succeeding E. J. McVeigh.

J. R. Bennington, assistant purchasing agent of the Lehigh & New England, with headquarters at Philadelphia, Pa., has been promoted to purchasing agent, with the same headquarters, succeeding E. Hughes, who has resigned.

E. J. McVeigh, general storekeeper of the Central region of the Canadian National, with headquarters at Toronto, Ont., has been appointed superintendent of reclamation and scrap, with headquarters at Montreal, Que., a newly created position.

R. J. Elliott, purchasing agent of the Northern Pacific, with headquarters at St. Paul, Minn., has been placed in charge of the purchasing and stores department to succeed F. G. Prest, director of purchases, who has retired under the pension rules after 44 years of continuous service with this company.

A Locomotive of Civil War Days

Railway Mechanical Engineer

Vol. 98 September, 1924 No. 9

The Unaflow Locomotive

One of the remarkable results obtained in the tests of the unaflow locomotive, which is described on another page of this issue, is the reduction of back pressure in the cylinders to a point considerably below atmosphere. This, of course, increases the efficiency of the steam cycle, as the temperature of the exhaust steam is lowered. Stationary engineers have long been able to take advantage of the savings resulting from a vacuum in the cylinders by employing a condenser, but the problem of providing a condensing apparatus for the steam locomotive of the reciprocating type has never been solved satisfactorily. Opposed to the need of reducing the back pressure is the necessity of creating a strong artificial draft in the fire box so that high rates of combustion may be maintained. This, no doubt, has tended to retard experimental work along the line of reducing back pressure in the cylinders. If the operating economies resulted in only reducing the back pressure to atmosphere the unaflow system would be worth serious consideration by locomotive designers. According to the figures reported from actual tests, it produced a vacuum as high as 60 per cent. This development of the steam locomotive promises results of practical importance which justify its intensive development.

Importance of Committee Work

It is a hopeful sign when the leaders of any industry recognize the need of joint action on mutual problems and, by faithful support of their national association and willingness to perform committee work at some personal sacrifice if necessary, do their best to promote the interests of the industry as a whole. From a purely selfish point of view this form of activity is highly remunerative. It brings men in contact with some of the leading minds in their particular branch of industry. They are broadened thereby and, moreover, have an opportunity to see and compare the merits of the best modern practices and methods. One man who has labored faithfully in railroad association work testifies that he has never attended a committee meeting at which he failed to get some idea which was worth investigating or perhaps trying out on his road.

Until a year or two ago a considerable number of railroad mechanical men failed to realize fully the opportunities of committee work in their association, either refusing to serve when their names were suggested for committee membership or permitting the use of their names and then practically never attending the meetings, answering queries or doing any constructive committee work. This condition has been most happily remedied, there being now an evident willingness on the part of practically all members of the Mechanical Division of the American Railway Association to serve on committees to which it is thought their experience will bring strength. Many of these men are now asking for work and in some cases the railroad heads have asked that their mechanical representatives be placed on committees.

Practically all assignments to committee work at the present time are accepted, and when on occasion it is impossible for a mechanical officer to serve, the reason is usually carefully and somewhat apologetically given. When once appointment on a committee is accepted, apparently every effort is put forth to do the best possible work for the committee and to attend meetings faithfully. The quality of the reports presented at the Mechanical Division convention at Atlantic City in June is proof of the faithful work done by committee members during 1923. Secretary Hawthorne of the Mechanical Division is authority for the statement that attendance at the committee meetings during the year was practically 100 per cent. For the benefit of the railroads as a whole, this kind of work should be continued.

Real Apprentice Training

The last of a series of four articles describing in detail apprenticeship methods on the Atchison, Topeka & Santa Fe appears in this issue on page 527. For a quarter of a century or more this publication and its predecessor, the American Engineer and Railroad Journal, have consistently advocated better and more effective methods for training apprentices in the mechanical department of the railroads. Nineteen years ago George M. Basford, at that time editor of the American Engineer and Railroad Journal, made an address before the American Railway Master Mechanics' Association on the technical education of railroad employees. This made a profound impression on mechanical department officers at that time and was followed by constructive developments on at least two roads.

John Purcell of the Santa Fe had always taken a deep interest in apprentice training. Mr. Basford had followed developments on the Santa Fe closely and with keen admiration for the intelligent and sympathetic interest in apprentices on the part of Mr. Purcell. Undoubtedly, also, Mr. Purcell was inspired by Mr. Basford's grasp of the importance and necessity for improving apprenticeship training methods. At any rate, the Santa Fe began to make remarkable forward strides in perfecting its apprenticeship methods. J. F. Deems, at that time general superintendent of motive power of the New York Central, was also greatly impressed with Mr. Basford's point of view and, with Mr. Basford's help, inaugurated a splendid system of apprenticeship training on the New York Central Lines. Unfortunately, while this work developed rapidly and was widely heralded, it has not been consistently carried on because of various changes in the organization. It was based on sound principles and the methods were carefully and logically developed. To some extent the work persists today, but it has not been followed up with the same persistent and intelligent effort that has characterized the Santa Fe developments.

Mr. Purcell never for a moment faltered in his effort to

make the apprenticeship training methods on the Santa Fe as constructive and effective as possible. He has been ably supported by Frank Thomas, who has given all of his energies to improving and extending the work. One secret of the success of this movement on the Santa Fe has been that in addition to the fact that no pains have been spared to carry it on, both Mr. Purcell and Mr. Thomas have a very keen sympathy for boys and young men—a sympathy so strong that it has led them, in developing their methods, constantly to strive to keep in mind the boys' point of view.

The apprenticeship methods on the Santa Fe have proved their practical worth in a large way in spite of the most severe tests to which they have been subjected. Mr. Purcell in his presidential address before the meeting of the Mechanical Division of the American Railway Association at Chicago in June, 1923, clearly emphasized the advantages of modern apprenticeship methods. This caused an awakening of interest on the part of many railroad officers and the *Railway Mechanical Engineer* immediately set about to arrange for a series of articles covering these methods in as great detail as practical, in order to give its readers a clear idea of just how the work is carried on. It has been a great source of satisfaction to us that these articles, following the results of the apprentice competition conducted by this publication a year ago, have attracted widespread interest. From the inquiries which have been made at our offices and of Mr. Purcell and his associates, we feel sure that the year 1924 is going to mark the greatest forward step which has ever been taken by the railways in the more general adoption of modern and up-to-date apprenticeship methods. Surely, in these days, when industry and the railroads at large are beginning to recognize the necessity for trained leadership, as well as the development of a more intelligent and constructive interest in industry and the railroads on the part of all of the workers, no mechanical department officer can afford to conduct apprenticeship training in an inefficient and haphazard manner. The Santa Fe has pointed the way. It has secured excellent and worthwhile results under the most severe conditions and over a long period of years. Is there any excuse for any railway mechanical department officer who fails to face squarely up to this problem by providing an up-to-date apprenticeship system in conformance with the principles which were adopted as recommended practice by the American Railway Master Mechanics' Association many years ago, but which until comparatively recently, have never received the serious consideration of more than a very few motive power officers?

Transmissions for Internal Combustion Engine Units

The successful operating results that have been obtained on many roads from the introduction of self-propelled motor cars has strengthened a demand for similar cars of greater carrying capacity. To meet this demand, new designs are being brought out. In addition, the high thermal efficiency and increasing reliability of heavy oil engines of the Diesel type are attracting a well-merited attention by progressive railroad men. The near future will very likely see a number of attempts to utilize such internal combustion engines for driving both cars and locomotives. The power transmission problem has always been a serious one in connection with the adaptation of either gasoline or heavy oil engines to railway motive power units and the problem becomes increasingly difficult as the size of the units is increased. Although mechanical transmissions as developed by the automotive industry have proved satisfactory in smaller capacities they lack complete flexibility of control. Ample starting torque, complete speed control and reliability are, however, vital if internal combustion engines are to be extensively employed for railroad motive power. Two methods of transmission appear to offer solutions of this difficult problem. One is the hydraulic system. This system has been tested to a limited extent in Europe and is now used on a switching locomotive in Canada and on a rail motor car on an American road. The other method is the electrical one, the engine being coupled to an electric generator and motors applied to the axles or trucks. This system was used on some of the early motor cars and is again being employed on some of the latest designs of locomotives and heavy rail cars. Both of these systems furnish good starting torque and full speed control, although neither is as simple or as low in initial cost as mechanical transmission mechanisms. Which one of the two systems will eventually prove to be the best suited for heavy railroad units only time and a considerable number of applications can determine. Both appear to warrant serious attention and should be considered in planning for new installations.

Railroad Shop Drilling

Which is the more important from a production point of view, the drilling machine or the operator? This question is akin to that other famous inquiry, "Which comes first, the hen or the egg?" A good drill operator handicapped by an antiquated machine cannot achieve the desired results in drilling holes, and, on the other hand, the most modern, powerful and conveniently-operated drill cannot produce the output rightfully expected of it with an indifferent operator. According to an old analysis which probably holds approximately true under present conditions, 17 per cent of the machine operations in railroad shops are drilling operations. The need for efficiency in this work is therefore apparent, both because of the possibility of decreased labor cost and because the more rapid handling of drilling work will to a certain extent help speed cars and locomotives through the shops.

Many drilling machines at present used in railroad shops and engine terminals have unquestionably outlived their period of effective usefulness. In some cases the driving motor is too small, or the driving pulley and belt does not transmit sufficient power to operate the machines at the desired cutting feeds and speeds. In other cases the clutches and gear shift mechanism for transmitting power within the machine itself are inadequate for present-day needs. Sometimes the spindle bearings are worn, or in the case of radial drills, the head bearings on the radial arm are worn beyond the point where lost motion can be taken up, with the result that the drill spindle wabbles literally "like a drunken sailor." Under such conditions it is obvious that the desired results in the production of drilled holes cannot be obtained. The best solution is to scrap the old machines as soon as possible and replace them with modern high-power drills, not forgetting that the requirements for railroad shop drilling machines are: First, adequate power for the job in hand; second, rugged design and construction to withstand the stress encountered in this class of heavy duty work; third, convenience of starting and stopping and changing from one feed and speed to another in order to conserve the operator's time and provide increased production.

In deciding on the type of drilling machine to be purchased another point to be remembered is that many railroad shop drilling operations are adequate in volume to require the full time of one or more machines and it would therefore be poor judgment to install expensive "full jeweled" drills with 30 or more speed changes when possibly less than six are used. In cases of this kind the requirements of power and ruggedness in drilling machines should be looked for and other expensive refinements eliminated.

Railroad shop managements can undoubtedly in some cases improve the present condition of their drilling equip-

ment by the addition of more powerful driving motors and perhaps in some cases by the repair and adjustment of drills. In the main, however, this is highly specialized work which the manufacturers are far better able to do both from the point of view of equipment and experience.

Besides providing better equipment shop managements can improve their drilling production by the education of drill operators as to what the modern drill can, and should, produce in the way of drilled holes. They should also provide all possible incentive and encouragement for the operators to secure this production. While it is probably not common practice, drill operators have been observed in railroad shops to operate their machines for half a day in the drilling of miscellaneous holes of all sizes in several different kinds of material without once changing the feed or speed. This is a case of pure indifference and reflects both on the drill operator and his supervisor. Either he doesn't know the relation between size of hole, feed and speed for any given material, or he doesn't care. In one case he should be instructed and in the other given an opportunity to change his attitude or compelled to work elsewhere. If he cannot be discharged, at least he can be put on some other job where he will not waste the power and time of the machine as well as his own.

Drill operators are usually paid the same rate as machinist helpers and often they adopt the "don't care" attitude because of failure to see that such an attitude will, in addition to hurting the company, delay their own advancement. Such men should be appealed to on the ground of ambition and pride of accomplishment. They should be shown the possibilities of production with modern drilling machines and high speed drills and taught to put up the feeds and speeds to the required point, changing them as often as may be necessitated by the varying size of holes and material to be drilled. Tests conducted at the Atlantic City convention indicated that with one-inch high speed drills and special drilling machinery penetrations up to 116 in. per minute in cast iron, 50 in. per minute in machinery steel and 5 in. per minute in Chrome nickel steel could be obtained. In these tests the maximum possible service was obtained from the drills, the speed being put up to a point slightly below that at which they would burn and the feed increased until the drills were near the breaking point. While these rates of penetration were obtained under special test conditions, railroad shop drills and drilling operations could be improved until a production equal to 50 per cent of these records was obtained and yet show a marked improvement over present practice in many shops.

Reports Should Be Studied

At every engine terminal or shop of any importance reports, charts or graphs are prepared for the foremen and their superior officers, which show on a monthly comparative basis various phases of the work performed. Considerable time and money is involved in the preparation of these reports by the clerical force of the various departments. The question is, do they serve their intended purpose? Those for whom the reports are intended should study them with a view to understanding the reason for them, the information contained in them and how best to use that information in obtaining better results. That this may be accomplished, detailed instructions should be issued with each report setting forth clearly how the data were obtained, the method of deriving the results shown and the object aimed at in issuing the report. Furthermore, after the supervisors have had ample time to digest the written instructions they should be called into the office where the report is prepared and closely questioned as to whether the report is fully understood. The men should be taught that the reports are not prepared primarily for the general officers of the railroad but that, except in rare instances, they are planned to provide the immediate supervisory officers with a record of the work being done. These reports should regularly be used to provide a proper incentive for the supervisors, to compare their work and their results with others and to use the results shown to inspire their associates and subordinates. Reports using the man-hour unit of measure for determining the cost of work done on locomotives and cars can be used to a good advantage if properly studied. Beneficial results can be obtained in studying the cost for each class of work performed on equipment by measuring the results in man-hours, not only for labor but for material as well. If reports of this nature are properly explained and exhibited to the workmen each month, they will know what their work is costing in comparison to that done by their associates. This will create an incentive for efficiency and economy. Foremen should be taught to analyze and use reports of this kind so that they can in turn, convey the information among their subordinates and associates and use it if they are promoted to positions of greater authority and responsibility. If they are not used as is too often the case, how can the cost of their compilation be justified?

New Books

Car Inspector's Handbook. *By E. W. Hartough, formerly general car foreman on Missouri, Kansas and Texas and Pere Marquette, 284 pages, 4½ in. by 7 in. Price $2.50. Published by the Simmons-Boardman Publishing Company, 30 Church Street, New York.*

The object of this book is to give to every interested car inspector an opportunity to obtain knowledge of his duties which could otherwise be obtained only by years of experience. The text of the book contains 23 chapters, which include train yard inspection, repair track inspection, shop inspection and interchange inspection, with many illustrations to make the subject clear. Any part of a car that requires inspection is thoroughly gone into with respect to method of inspection, what to look for, how to report the existing defects and how to designate the defect so the repairman will know what to do. An interesting chapter is devoted to interchange inspectors, which brings out the importance of their work and the thorough knowledge they must have of the rules and regulations governing their duties. The volume clearly brings out the important part which inspectors play in helping to maintain equipment and reduce repair costs and in protecting human life and property.

Arc Welding Handbook. *By C. J. Holslag, chief engineer, Electric Arc Cutting & Welding Co., 243 pages, 4¾ in. by 7½ in. Price $2.00. Published by the McGraw Hill Book Company, Inc., 370 Seventh ave., New York.*

This book describes clearly and in detail the methods of arc welding so that the equipment and processes may be thoroughly understood and the newer applications of this branch of welding more generally recognized. It is a complete working manual for welding operators and those who supervise welding jobs, and also an adequate reference guide for all concerned in any way with the use of arc welding. It describes the process of stubbing and holding an arc and points out clearly what should be done to get the best results.

Different types of welding are treated completely. Starting with definite instructions as to the formation of beads, the author covers spreading welding, over-head welding, padding welding, fillet welding, lap welding, butt welding, etc. Specific applications of arc welding are included in specific sections. Definite directions are given in chapter 15, for instance, for the successful welding of cast iron and malleable iron. In chapter 16 the welding of thin cast-iron

sections is covered. Other chapters describe the welding of all of the commonly used metals for many usual and unusual jobs. It is a plain and practical guide to its modern uses which will prove of material help to those interested in arc welding.

THE ENGINEERING INDEX—1923. 700 *pages*, 6½ *in. by* 9½ *in. Bound in cloth. Published by the American Society of Mechanical Engineers, New York.*

The twenty-second volume of the Engineering Index is the fifth one to be issued since The American Society of Mechanical Engineers acquired the Index from The Engineering Magazine Company and assumed the continuation of the service started 40 years ago by the Association of Engineering Societies. The typographical arrangement of the 1923 volume follows that of its predecessor with the exception of an improvement in the style of the main headings. It contains a brief review and index of articles which have appeared in publications and reports covering a wide variety of engineering subjects. In the preparation of this volume the staff of the Society reviewed publications in several different languages and this edition of the Index presents what is probably the most complete reference to current literature on engineering and scientific subjects in existence.

The wide range of usefulness of this edition should particularly appeal to men in the railway field. Practically every phase of the construction, maintenance and operation of motive power, rolling stock, shops, terminals, signaling, track and yards have been covered by references to articles published in the leading technical magazines of the United States and foreign countries.

PROCEEDINGS OF THE AIR BRAKE ASSOCIATION 1924. *Edited by the Secretary, F. M. Nellis,* 165 *Broadway, New York,* 315 *pages, bound in leather.*

This book contains the proceedings of the Thirty-first Annual Convention of the Air Brake Association which was held at Montreal, Quebec, Canada, May 6, 7, 8 and 9, 1924. The reports submitted covered Brake Pipe Leakage; Freight Car Foundation Brake Design; Condemning Limits of the A. R. A. Standard Triple Valve Parts; The Triple Valve Test Rack Operator; Reclamation of Air Brake Material; Reclamation of Hose and Fittings; Passenger Train Handling; Graduated Release; Methods of Interesting and Instructing Railway Employees in the Maintenance and Operation of the Air Brake Equipment; Recommended Practice. The reports of the secretary, treasurer and various committees are also included.

What Our Readers Think

Boiler Inspectors Should Be Examined

TOLEDO, Ohio.

TO THE EDITOR:

One has but to read the federal inspection reports to have most forcibly impressed upon him the importance of the roundhouse boiler inspector's position. It is one that carries with it the practical control of life or death for many. We have a certain sense of security when we see monthly, quarterly or yearly certificates in an engine cab and note that so-and-so by his signature and oath declares that the boiler is in safe condition to operate. Yet how much more secure we would feel if our federal laws would make it compulsory for all boiler inspectors to pass an examination conducted by federal inspectors. It would result in the weeding out of many that are not competent to hold these positions. The necessary qualifications for such positions are well defined by three requisites: Practical knowledge of boiler construction and repair, good judgment and, last but not least, the moral stamina to say no and stick to it. It is well known that many so-called inspectors have signed certificates and engines have gone into service with disastrous results, when, if they had not been so anxious to keep on the right side of their supervisors, they would have refused to sign. That is the great drawback to the proper carrying out of the law. Put the boiler inspector's position on a plane where local supervision would have no terrors for him and, with qualified inspectors, all would benefit.

In the proceedings of the recent Master Boiler Makers' convention men high in the official life of our great railroads spoke of the necessity of acquiring a staff of competent boiler inspectors. Surely these men know the necessity of such a program and it argues well for the future and speeds the day when the roundhouse boiler inspector will not be looked upon as a disturbing element in the roundhouse, but rather as one with the possibilities and importance of his position fully recognized. JOSEPH SMITH.

Qualifications for a Gang Foreman

EAST ORANGE, N. J.

TO THE EDITOR:

I have read with considerable interest your editorial in the August number of the *Railway Mechanical Engineer* on the subject of selecting a man for a gang foreman. This is a subject on which much has been said, but in many respects the problem is covered by that old saying that what looks well in theory, doesn't always work in actual practice. There are very few men living today who would come up to the specifications outlined in your editorial; in fact, I think most of them are dead.

Of course, what you have outlined are essential qualities of a foreman, but I do think that the degree in which a man will possess these essentials will vary according to the individual. I know of many foremen and supervisory officers who, after they have once been given authority, have taken upon themselves an unnatural personality which, doubtless, they believe fits the job better than the personality that the Lord gave to them. When a man has to change his countenance, expression of speech and his conduct with others in order to successfully hold down a foreman's job, it is done solely for the purpose of disguising his inherent shortcomings. Therefore, I maintain that the essential qualities of a foreman are first of all true personality, honesty and an earnest desire to produce the goods. A READER.

Who Can Answer This Inquiry?

TOLEDO, OHIO.

TO THE EDITOR:

Can some reader of the *Railway Mechanical Engineer* furnish any information in answer to the following questions:

1. How many months of service should be had from a new set of side rod bushings on an eight-wheel switch engine that is used on Belt line service working 24 hr. a day and 315 days a year?
2. How many months' service should be had from a new set of tires before it is necessary to turn them? This is for the same class of service and the same type of locomotive as given in the first question. Would 1/32 in. wear for every 30 days be a fair average?
3. How many months' service should be had from a set of two-inch driving box crown brasses equipped with grease cellars, on the same type locomotive and in the same class of service, working 24 hr. a day and 315 days a year? SHOP FOREMAN.

A Unaflow Locomotive is Built for Russia

A Remarkably High Vacuum Has Been Obtained by Redesigning the Cylinder Exhaust Pipes

By Prof. J. Stumpf

Privy Counsellor, Berlin, Germany

THE first locomotive in which the unaflow principle was applied was a superheater freight locomotive of the German State Railways, was built in 1920 by A. Borsig, Berlin.* This locomotive did not prove to be a success and after operating about three years the cylinders were replaced by those of the usual type. The cylinders first used for the unaflow installation were notable for compactness, lightness and simplicity. This was due in part to the use of horizontal, single-beat poppet valves which

The 0-10-0 Unaflow Locomotive Built by Nydquist & Holm, Trollhättan, Sweden, for the Russian Government

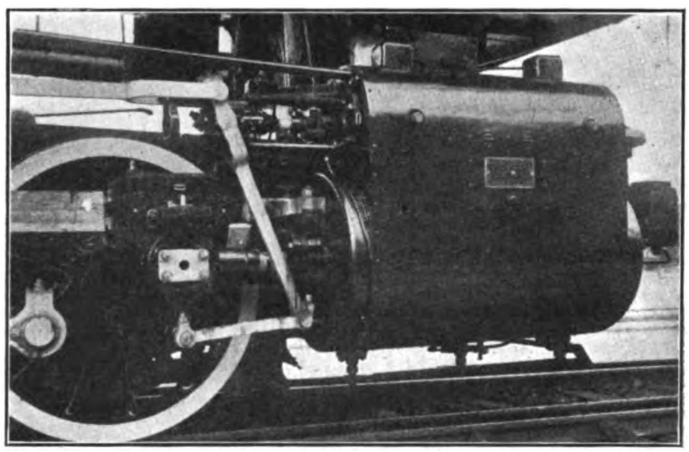
were employed for the first time on this locomotive. This type of valve, although simple and perfectly steam tight, was not favorably received because of the high lift and large force required to raise it. The cylinder bore of this locomotive was 24.8 in., with a stroke of 26 in. and it operated at a steam pressure of 177 lb. per sq. in.

The results of tests made at that time showed that the unaflow locomotive was more economical than the compound for small loads, while at higher loads its fuel consumption was higher than that of the latter. This was easily explained by the fact of the long, constant compression and the large clearance volume. The unaflow locomotive working with saturated steam showed in general a higher economy than the compound except at long cut-offs. It was concluded, at that time, that the future line of progress of the unaflow locomotive led naturally from the two cylinder to the three cylinder engine with cylinders having small clearance volume, to the use of single-beat poppet valves and the utilization of the ejector action of the exhaust, in combination with high pressure and modern superheat.

To engineers of broad vision, unsuccessful experiments are successful if they reveal the way in which success may be sought. So it was here. The exhaust ports in the cylinder wall, which are formed like a nozzle of a steam turbine, transformed the energy of the "lost toe" of the indicator card into speed energy, which withdrew residual steam from the attached single exhaust pipe. A vacuum of 60 per cent was created in this pipe, leading from the cylinders to the ejector, thus utilizing this energy, represented by the "lost toe," for creating the vacuum.

Fig. 2 shows an indicator diagram taken from the single exhaust pipe. This test was a complete success as it showed that on account of faulty connection between the cylinder and the evacuated exhaust pipe, the vacuum did not penetrate into the cylinder. The locomotive was of the pure unaflow type and it was discovered that the exhaust ports in the cylinder were closed too soon by the piston. Also the single beat valves did not prove to be a success on account of the fact that the crew failed to adjust the gear properly. However, this engine revealed the method by which success was to be expected.

The single beat valves were replaced by a positively controlled piston valve allowing for an additional exhaust which partially followed upon the main exhaust controlled by the piston. This design permitted the main exhaust nozzle to transform the pressure energy represented by the "lost toe" of the diagram, which is shaded in Fig. 1, into speed energy, so as to withdraw the residual steam from its own and of the other cylinder through the additional exhaust established by the piston valve. The gain thereby effected is shown by



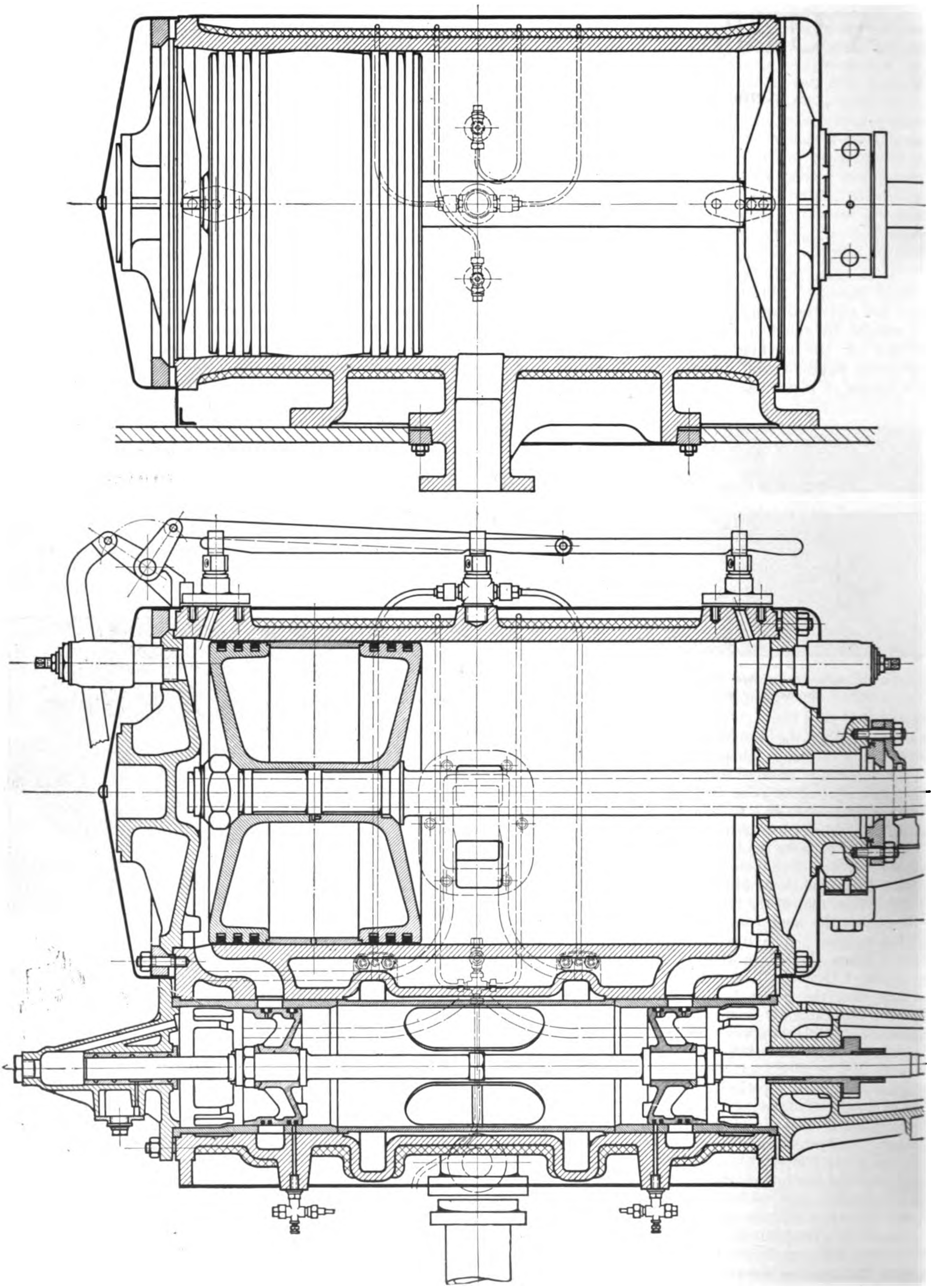
The Locomotive Is Equipped with a Walschaert Valve Gear

the shaded area below the atmospheric line in Fig. 1 which corresponds to the results from actual indicator cards with about 60 per cent vacuum.

Design of the Cylinders and Exhaust Pipe

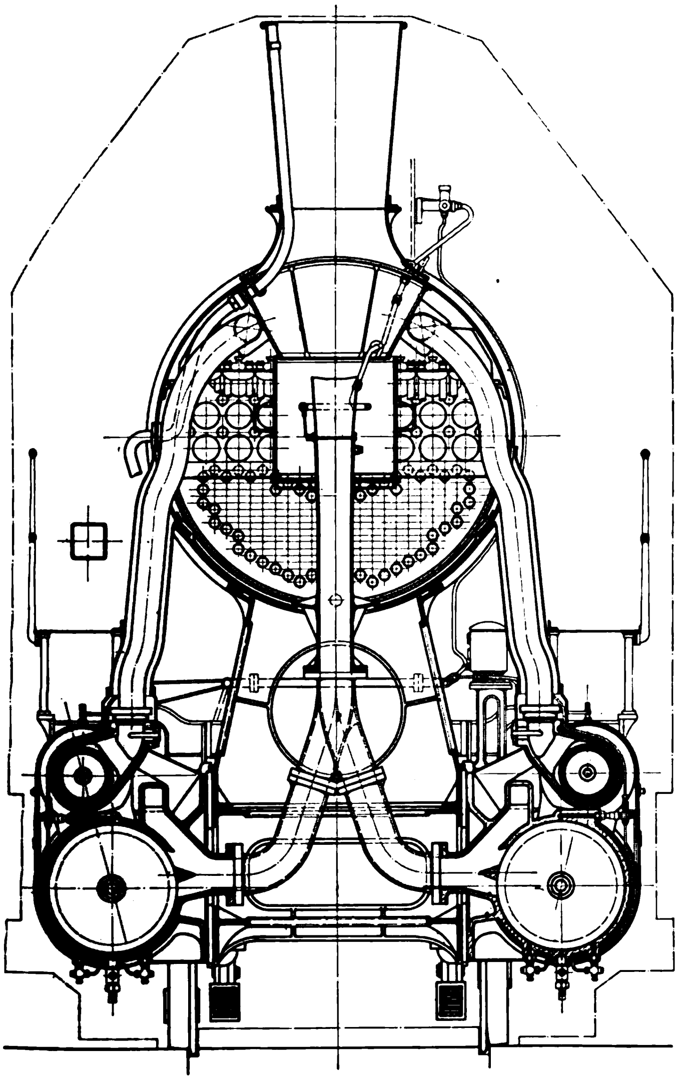
The design of the cylinders and exhaust pipe is shown in the drawings. Particular attention is drawn to the elongated type of the unaflow cylinders and pistons. The main nozzle-like exhaust ports are opened by the piston at 25 per cent of the piston stroke before the next dead center. No extended piston rod is used. Live steam is admitted to the cylinder from the inside of the piston valve in the usual way, the outer ends establishing an additional exhaust which joins the main exhaust immediately at the cylinder wall by ports cast in the wall. The exhaust lap of the valve is equal to the inlet lap, thereby delaying the additional exhaust which follows the main exhaust. This tends to effect a nearly pure unaflow at early cut-off and a semi-unaflow at late cut-off. This is an satisfactory result as there is prac-

* A description of this locomotive was published in the May, 1922, number of the *Railway Mechanical Engineer*.



Sectional Drawing Showing the Construction of the Cylinders

tically no loss at the end of the diagram at early cut-off which shows there is no need for an additional exhaust at this point and as there is considerable loss at the end of the diagram at late cut-off there is consequently a need there of an additional exhaust. Furthermore, when working with atmospheric exhaust, the pure unaflow shows greater economy at early cut-off and the semi-unaflow at late cut-off. This contrast is more favorably intensified by utilizing the lost part of the diagram to create vacuum at late cut-off. The output and economy of the locomotive will be largely increased if the back pressure of about one atmosphere, with which American locomotives are frequently worked, is replaced by a vacuum. This is all the more

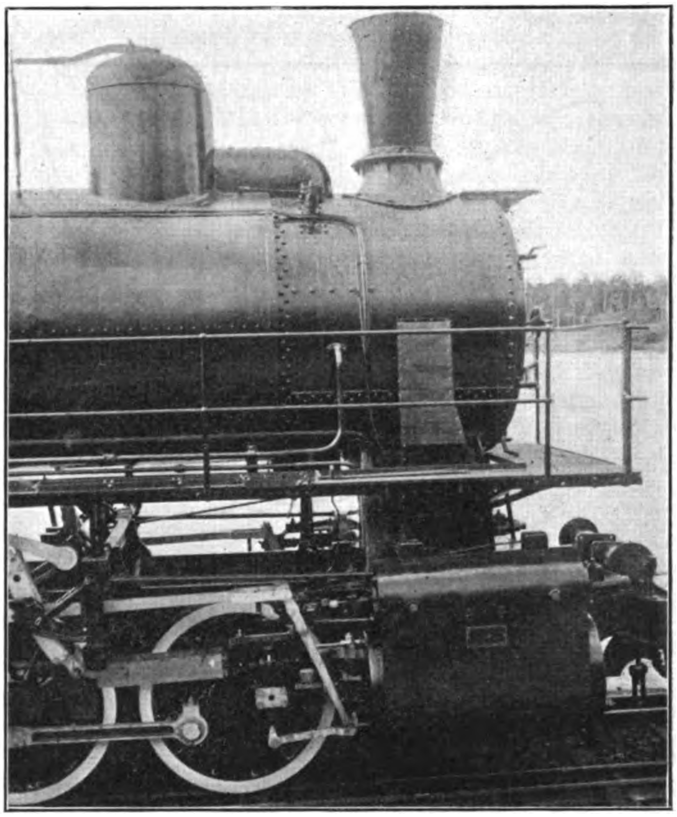


Cross Sectional Elevation Through the Smokebox Showing the Arrangement of the Cylinder Exhaust Pipes

noticeable since the unaflow system shows its beneficial thermal effect especially the larger the drop of temperature in the cylinder. The boiler will be more able to furnish the required steam, the capacity of the locomotive will be increased and in a great many cases the necessity to use a mechanical stoker will be dispensed with as the fuel consumption of the locomotive will be considerably lessened.

Effect of Uniting the Cylinder Exhaust Pipes

After the union of the three exhausts of each cylinder both united exhaust pipes become a combined ejector, so that the exhaust of each cylinder evacuates the other. By this arrangement the speed energy of one cylinder will evacuate its own cylinder as well as the other, the active steam thus mixing with the passive steam at two places and equalizing



The Front End of the Russian Unaflow Locomotive

the speed of the steam through the exhaust pipes to a large extent. This equalization is continued in the nozzle which transforms the speed energy into pressure energy, thus utilizing any remaining energy that may be left from the exhausts. The result is a fairly equalized flow of steam from the mouth of the nozzle, which tends to create a uniform draft upon the flue gases, resulting in good combustion and a good production of steam. There has never been the slightest complaint about lack of steam.

Further examination of the results in testing this peculiar suction exhaust showed a surprisingly low vacuum in the

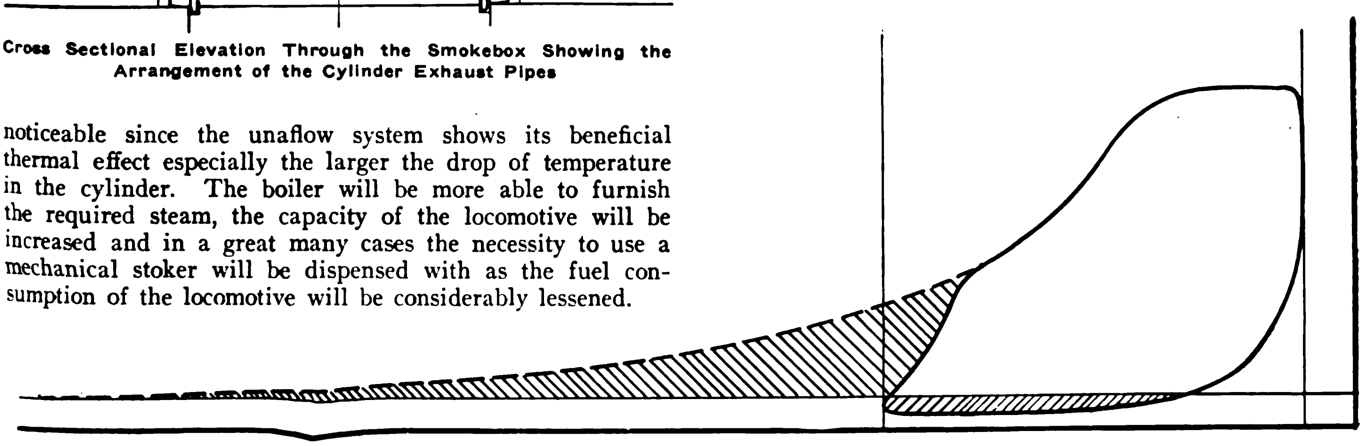
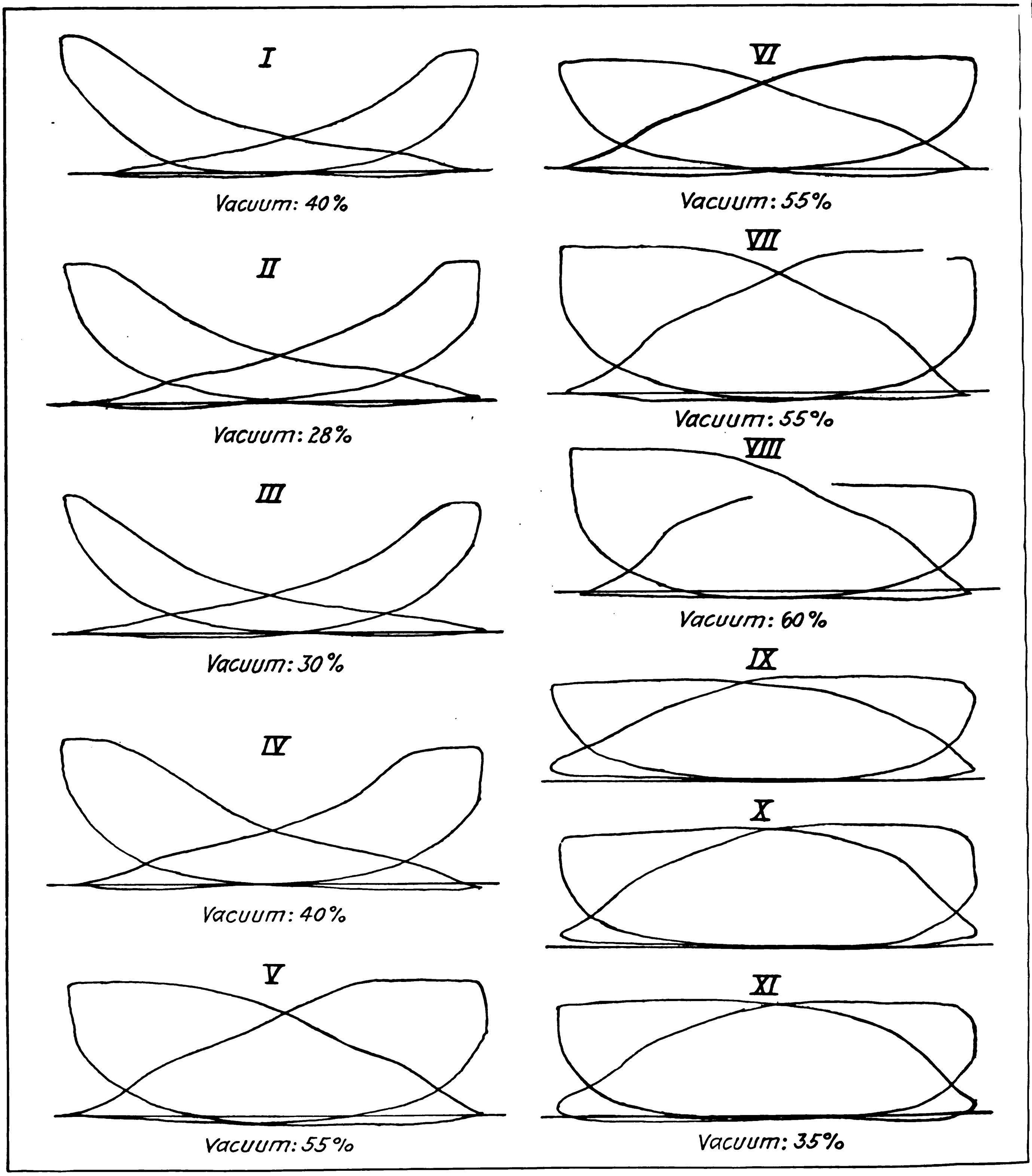


Fig. 1—A Theoretical Indicator Card in Which the Shaded Area Below the Atmospheric Line Shows the Gain in Pressure Energy Exhaust Ejector Action

smoke box, that the fireman carried an unusually light fire, that there was little surplus air and a relatively small amount of carbon monoxide. There was also considerable moist steam at the mouth of the stack which showed that the steam was performing an increased amount of work. This increased work is shown in Fig. 1 by the shaded area below the atmospheric line, which, however, amounts only to 14 per cent of the lost work represented by the shaded area above the atmospheric line. It also showed that the suction exhaust was working with an extremely bad efficiency, which opens the prospect of realizing a much better vacuum if proper measures to that end are taken. In fact a vacuum of 80 per cent should be easily attainable. This design can be improved in a great many ways; for example, the spider placed in the mouth of the nozzle should be removed in order to give more area for the exit of the flue gases.

Construction of the Cylinders

Referring to the sectional drawing of the cylinder it will be noted that the prolongation of the cylinder and piston is



Indicator Cards I to IV Inclusive Are Taken at Low Speeds; V and VI Are Taken at High Speeds and VII and VIII Are Taken at Medium Speeds; Cards IX, X and XI Are Starting Diagrams

remarkably small due to the large advance in the exhaust of 25 per cent, which increases the lost area of the diagram in Fig. 1 to a large extent. The bull ring inserted between the two piston heads carries the piston. No hard bushing is used

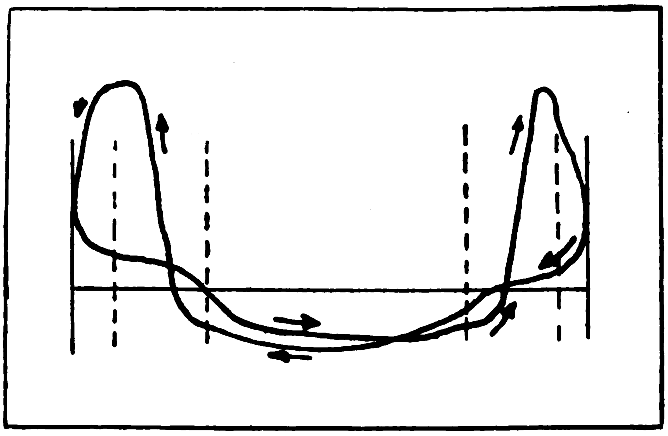


Fig. 2—Indicator Diagram Taken from a Single Exhaust Pipe

in the cylinder itself. The clearance space is 12 per cent, which could be reduced to quite an extent if blowing of the cylinder safety valves is resorted to at very early cut-offs. Referring to the drawing of the indicator cards, a vacuum of from 28 per cent to 40 per cent is obtained at 20 per cent cut-off, thereby compensating for the long compression entailed by the large exhaust lap of the piston valve. At 30 per cent cut-off a vacuum of 40 per cent is obtained, while at 50 per cent cut-off the tests showed from 55 per cent to 60 per cent vacuum. The last three cards shown in the drawing are starting diagrams, taken at 70 per cent cut-off. The time between exhausts is so large that the returning air pressure destroys the vacuum, but it will come up as soon as the speed is increased sufficiently, as is shown in the last card. The speed, of course, is an important factor in this peculiar process of producing a vacuum and obviously a three-cylinder locomotive will be more adaptable to produce a vacuum, which in this case may be termed a mechanical

A general idea of this locomotive may be obtained from the illustrations. It is an 0-10-0 type equipped with a standard Walschaert valve gear, which in this connection has some bad features. In spite of these bad features, however, a considerable saving in steam and coal may be expected.

It is left to the reader to imagine what field is available for the condensing turbine locomotive if there should be a vacuum produced with the unaflow system, for a medium and long cut-off, equal to that of a turbine locomotive equipped with a condensing device. This question may be raised to good advantage, especially in America, where a long cut-off is commonly used.

Air Brake Investigation by I. C. C. Completed

The Adoption of More Complete Specifications for Maintenance and Operation Are Recommended

EARLY in August the Interstate Commerce Commission made public an opinion in its investigation of "power brakes and appliances for operating power-brake systems."

The opinion, from which three commissioners in part dissented, embodies the following conclusions:

Improvements in the operation of power brakes for both passenger and freight trains are essential and must be effected.

Improvements in power-brake appliances can be made and increased safety in train operation can and must be obtained.

A power-brake system for passenger and freight trains should insure that only a service application of the train brakes will occur when a service reduction of brake-pipe pressure is made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made from a fully charged brake system.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when emergency reduction of the brake-pipe pressure is made after a full service brake-pipe reduction has been made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made following release after a full service brake application.

A power-brake system for passenger and freight trains should provide means whereby the engineman can control the release of pressure from brake cylinders and effect such release by graduated steps or gradually in order that he may decrease as well as increase brake-cylinder pressures as required to control at relatively uniform rates the speed of trains.

A power-brake system for passenger and freight trains should provide for obtaining and maintaining brake-cylinder pressures within prescribed limits for specified periods of time during brake applications.

In addition to these general requirements it is clear that full specifications and requirements covering more fully the functions, maintenance, and operation of power brakes and appliances should be adopted. Consideration will be given to this and to the form of order to be issued by us. This case will be held open for that purpose.

This investigation has been under way since February, 1922, and was instigated on the petition of the Automatic Straight Air Brake Company. On March 24, 1922, a questionnaire was sent out calling on 196 carriers to furnish certain information relative to rules and practices in the use of hand brakes, the number of accidents resulting from failure promptly to control the speed of trains on grades and other related information.

It appeared that on 25 railroads hand brakes were used to control the speed of freight trains, or to supplement the power brakes in controlling the speed of such trains, not only on 122 grades for which specific data were furnished, but also on numerous branch lines. On 169 other railroads reporting a total of 1,807 grades, the speed of trains was controlled exclusively by power brakes. The information furnished under this head covered a total of 1,929 grades of 1 per cent or more having a length of 3 miles or more. In many cases the grades on which hand-brake operation was reported were less severe, both in percentage of gradient and length, than grades upon which trains were controlled entirely by means of power brakes. During the three-year period 1919-1921, inclusive; there occurred on these 1,929 grades 67 accidents, each of which resulted in personal injury or property loss of $500 or more, caused by failure properly to control the speed of trains. These accidents caused the death of 15 persons, the injury of 46 persons, and a property loss of $432,908. During the year 1921 the accidents attributed

to specific causes mentioned in our questionnaire numbered 1,336. These accidents caused the death of 19 persons, the injury of 1,305 persons, and entailed a property loss of $343,654.

History of Air Brake Development

The opinion of the commission follows the detailing of these facts with a history of the development of the air brake since 1870, including an outline of the work done by the Master Car Builders' Association and the present American Railway Association. Following a description of the evolution of the Westinghouse and New York Air Brake systems, the commission's report outlines the development of the Automatic Straight Air Brake Company's triple valve with particular and detailed reference to the rack tests and then the road tests on the Norfolk & Western.

At the hearings held in connection with this investigation, the Automatic Straight Air Brake Company presented evidence to show that certain defects were present in the power-brake devices in common use; also evidence of the developments, installations and services of the A. S. A. brake. It contended that the more general use of these devices would afford freedom from a number of troubles now commonly encountered and result in material improvement in power-brake operation.

Contend A. S. A. Brake Experimental

Other parties appearing at the hearings contended that the A. S. A. brake devices were still in an experimental stage; that service tests to which they had been subjected had not been sufficiently extensive to warrant final conclusions and that the demonstrations on the Norfolk & Western in 1921 were conducted under favorable conditions that did not represent the usual service conditions encountered on long trains of empty cars or with a leakage such as commonly exists.

After the hearing had been completed, in order to determine certain questions which conflicting evidence had introduced, the hearing was reopened April 27, 1923, for the purpose of a test by the I. C. C. Bureau of Safety of the Automatic Straight Air Brake equipment on the Norfolk & Western.

An abstract of the report on these tests as submitted by W. P. Borland, director of the Bureau of Safety, appeared in the *Railway Age* of March 1, 1924, page 500. Issue was taken with Mr. Borland's findings by various railway executives and their testimony will likewise be found in the *Railway Age* of March 8.

The tests on the Norfolk & Western were also observed by a committee of railway representatives headed by C. E. Chambers, superintendent of motive power of the Central of New Jersey and chairman of the Committee on Safety Appliances of the American Railway Association, Mechanical Division. The findings of this committee were considerably at variance with those of Mr. Borland. The commission's opinion discusses the points at issue and in general approves the findings of its own representatives.

Dissenting Opinion

Commissioner McManamy dissented from the majority opinion in part and discussed the report as follows:

The conclusions of the majority in this case are directed towards the accomplishment of two definite purposes, (*a*) better maintenance of existing power-brake systems, and (*b*) fundamental changes in the design of power-brake systems to make possible additional functions.

I am in full accord with the conclusion requiring better maintenance. The evidence abundantly shows the need for better maintenance of power-brake systems and the improved performance which will result therefrom. No witness, either for carriers, the brake manufacturers, or the employees, testified that power-brake systems as a whole were maintained in an efficient or satisfactory operating condition. On the contrary, every witness testified that improved performance would result from better maintenance and that such better maintenance should be required. I am not in agreement, however, with the conclusions which require changes in the design of power-brake systems in order to make possible the performance of additional functions not now included in existing standard freight brakes, because (1) the record does not show that the existing power-brake systems if properly maintained are inadequate to safely control trains; (2) if existing brake systems are adequate, I question our authority to require the use of improved devices; and (3) the investigations and tests are insufficient, to my mind, to definitely show that the proposed changes in design can be made without introducing undesirable features which will offset any benefits which may be derived therefrom.

In my opinion the basic question presented in this proceeding is: When properly maintained are existing power-brake systems adequate to safely control trains under present operating conditions? If we find in the affirmative, we should prescribe and enforce standards of maintenance that will insure proper performance and maximum efficiency of existing power-brake systems. In my opinion it has not been shown that present brake systems are inadequate; therefore a further question arises. If existing systems are adequate to safely and efficiently control trains, and if improved devices are available which are not being used, have we authority, in addition to requiring better maintenance of the power-brake systems in use, to also prescribe specifications and requirements which will compel the use of such improved devices? I question that section 26 of the act, under which this proceeding is brought, gives us such authority.

No Evidence Showing Brakes Inadequate

The outstanding feature of this case, to my mind, is the fact that the record is barren of evidence that the existing power-brake systems, when properly maintained are inadequate to safely and efficiently control trains under present-day operating conditions. This statement is supported by the majority report. For instance, the following appears in the report:

> Officials who are directly in charge of air-brake inspection and maintenance, and instruction of employees in air-brake operation on the lines of several of the carriers, testified in this proceeding. It was the consensus of opinion of these witnesses that the present freight brake equipment with K-type triple valves now generally in use is adequate and in accordance with the requirements of safety when properly maintained. With reference to improvements in power-brake appliances, the principal suggestion offered was that efforts to improve conditions of maintenance should be continued.

Efforts to improve power-brake systems should, without doubt, be diligently continued, and where it can be definitely shown that improvements in design have been made which would increase the safety of operation, such improvements should be incorporated in the existing power-brake systems. But, to my mind, the evidence in this case has fallen short of showing that improvements are available which do not, at the same time, possess undesirable features sufficient to counteract the good effects hoped for, thus leaving no net gain.

While the conclusions of the majority are stated in general terms and without reference to any particular type of brake, the report throughout is based upon a comparative test of the automatic straight air brake, in which all of the features recommended are said to be incorporated, and the Westinghouse brake, the one in general use. The additional features are not used on the latter, because they are said to be undesirable. It is unfair to select specific brake applications and attempt to base a conclusion thereon as to the relative merit of different power-brake systems. This was the principal cause for the disagreement between observers at the Norfolk & Western tests.

Viewing the situation in its broadest light, the present power-brake system has been in general use for more than half a century and from time to time changes and improvements have been made. It is in service on 2,500,000 cars and locomotives. The uncontradicted testimony of carriers' witnesses is that when properly maintained it safely and efficiently performs the required functions. This testimony is from representatives of railroads that are safely and satisfactorily controlling by means of power brakes heavy passenger and freight trains on the steepest mountain grades in the country. In view of this testimony we can not find that standard power-brake systems, properly maintained, do not meet every requirement of the law. On the other hand, the record shows that the other brake system has placed in service during the past few years only 199 brakes on four different railroads. Of these, 140 are on freight and 59 on passenger cars. The only information available respecting the performance of these brakes has been developed during the past two or three years and, in so far as the emergency features are concerned, is limited almost entirely to that resulting from the Norfolk & Western and Virginian tests. To my mind these tests alone are insufficient to form the basis of an order directing fundamental changes in the design of power-brake systems. If, based on these tests, we find that certain additional functions, such as emergency following release, emergency following service, or the ability to graduate brakes on or off can be performed, we must at the same time give consideration to the un-

desirable performances, which admittedly occurred during these tests, resulting from the changes in design. Among these are the effect of leakage variation in piston travel and the slowing up of serial action which are referred to in the report.

Satisfactory Braking for 100-Car Trains

Quick serial action of brakes required 30 years to develop to a point where it is possible to obtain satisfactory brake performance on 100-car freight trains. Briefly, it means that the action of the brakes throughout the train must be quicker than the action of the slack in the train. That is, the brake on each car must respond so quickly that each car will be stopped by its own brake and not by striking the car ahead. The tests show that substantially more time was required to apply the A. S. A. brakes on 100-car trains than to apply the standard brakes. This necessarily results in greater shocks and in greater damage. To my mind, the ability to make smooth stops is more important in freight-train braking than the ability to make quicker stops, and the testimony is uncontradicted that the shocks resulting from the emergency application of the A. S. A. brakes on the test trains were severe.

The testimony is conflicting as to whether or not the shocks were more severe than on similar trains equipped with standard brakes, and no tests were made to determine this point.

If the additional features to be incorporated will increase the severity of the shocks on long freight trains, which are at present a serious source of danger to train crews, it may well be that freight-train braking would be safer and more satisfactory without such a feature. It is well recognized that greater property damage and more personal injuries result from rough freight-train stops than from failure to get emergency action following release or following service.

The additional increased safety in mountain braking which comes from the additional supply of air carried on each vehicle with the A. S. A. brake is a factor which may well be given consideration, but the performance of the test trains did not afford opportunities for demonstrating what value this would be in an emergency.

For the above reasons I can not join with the majority in the conclusion that we should order fundamental changes in brake designs as stated in their report, without further evidence (1) of the need for such additional features and (2) of the possibility of their satisfactory performance. I believe, however, that further trial of these changes in design should be encouraged in every proper way.

I am authorized to state that Commissioners Eastman and Potter join in this expression.

Locomotive Resistance and Tractive Force

Machinery Losses Are Considered in Calculating the Resistance in Terms of Mechanical Efficiency

By Kiichi Asakura

Mechanical Engineer, Japanese Government Railways, Tokio, Japan

In an article on locomotive resistance and mechanical efficiency, published in the July 30, 1921, issue of the Railway Age, the writer stated that locomotive resistance is better expressed as a function of mechanical efficiency rather than in the usual form of pounds per ton of the total adhesive weight of the locomotive. This conclusion had been deduced from the results of several locomotive tests which were then available. However, a locomotive consists of a steam engine which is subject to steam losses. It is more than a steam engine, however, in that it is mounted upon a running gear which is also subjected to all the losses incident to any unit of rolling stock. A total of these losses constitutes what is defined as locomotive resistance and is understood to be a combination of the losses from the two sources just referred to.

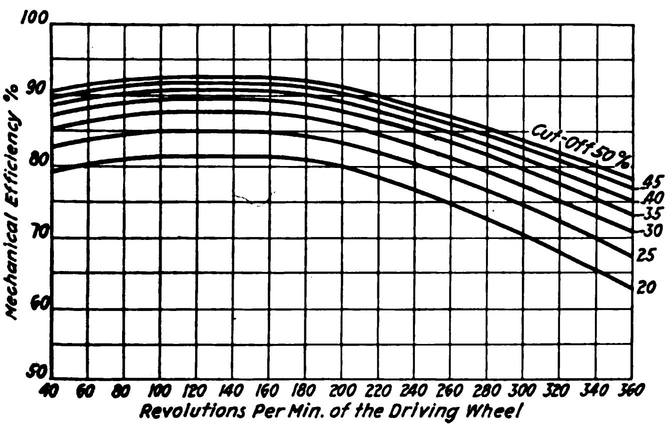


Fig. 1—Curves Plotted from the Results Obtained from the Formulas for Mechanical Efficiency

The latter are caused by such items as journal resistance and rolling friction which are affected by the weight of the locomotive. These may be equitably considered as proportional to the weight and it therefore becomes quite rational to express such resistance in terms of so many pounds per ton of locomotive weight. The kind of resistance thus covered is that which is developed by the locomotive as a unit of rolling stock and since it is caused by friction, it may and will be referred to herein as the rolling stock frictional resistance. This, together with the rolling stock air resistance, may be likewise termed the rolling stock resistance of the locomotive.

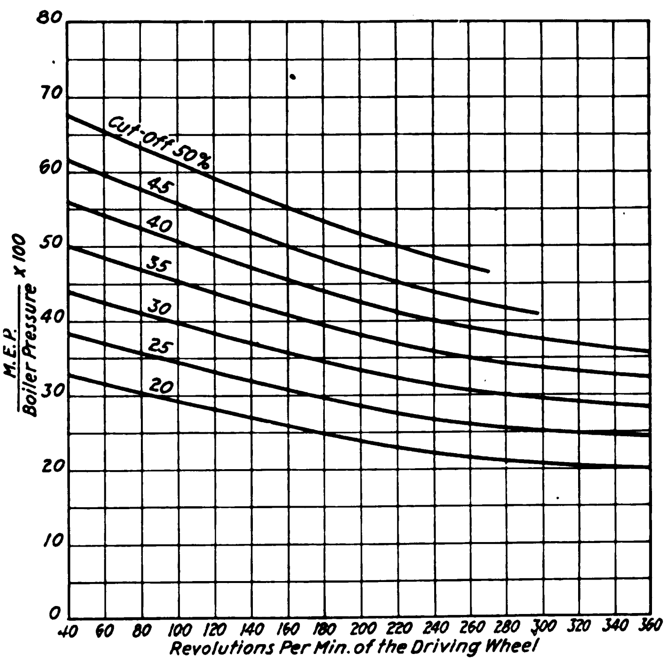


Fig. 2—Relation of the Ratio of the Mean Effective Pressure and the Boiler Pressure to Revolutions of the Driving Wheel

Steam engine losses are the greater and may be referred to as the engine resistance of the locomotive. Since the pres-

sure of steam in the cylinder is the source of the engine resistance and at the same time the source of the power developed, it should be quite reasonable to express engine resistance in terms of mechanical efficiency. Engine resistance and indicated horse power are functions of cut-off and of the driving wheels. The formula is plotted in curves as shown in Fig. 1.

For the development of these formulas, the engine resistance was calculated from the experimental data previously mentioned by subtracting the rolling stock frictional re-

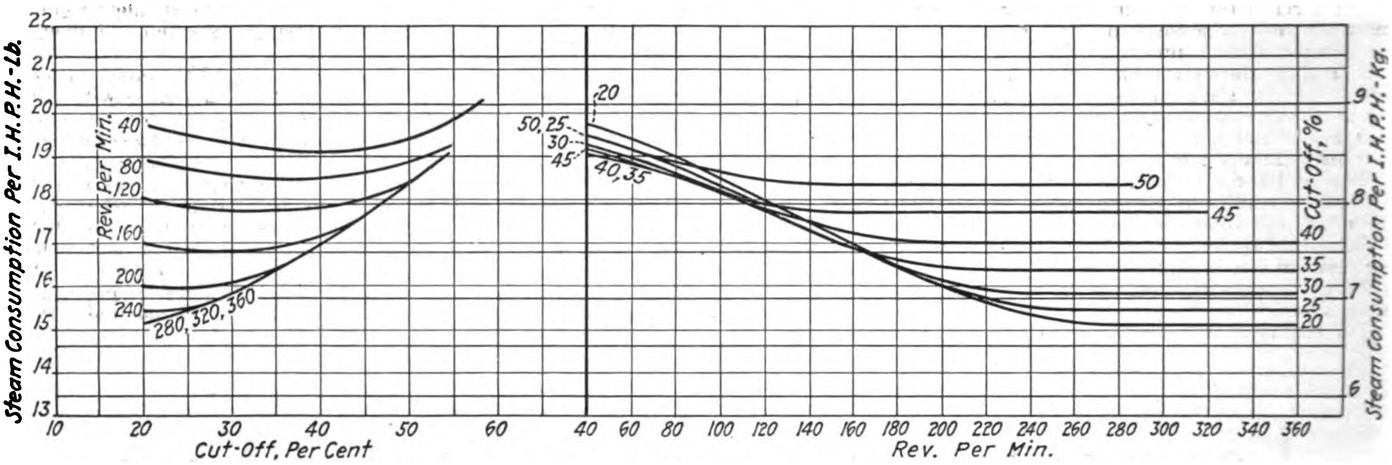


Fig. 3—Relation of Steam Consumption Per I. H. P. to the Per Cent Cut-Off and Driving Wheel Revolutions Per Minute

number of revolutions of the driving wheels. Therefore mechanical efficiency is expressed with reference to such terms. We can find no such reasons which will justify the thought that engine resistance is proportional to the total or adhesive weight of the locomotive. Nor do any experimental results support this idea.

Locomotive Resistance

In the article on locomotive resistance and mechanical efficiency a formula was developed for the expression of mechanical efficiency. Since, however, locomotive resistance consists of the two distinct factors referred to, namely, the rolling stock resistance and the engine resistance, and since the latter is only to be expressed as a function of mechanical efficiency, the formula must undergo some alteration. From the same data which was used in the former article, a

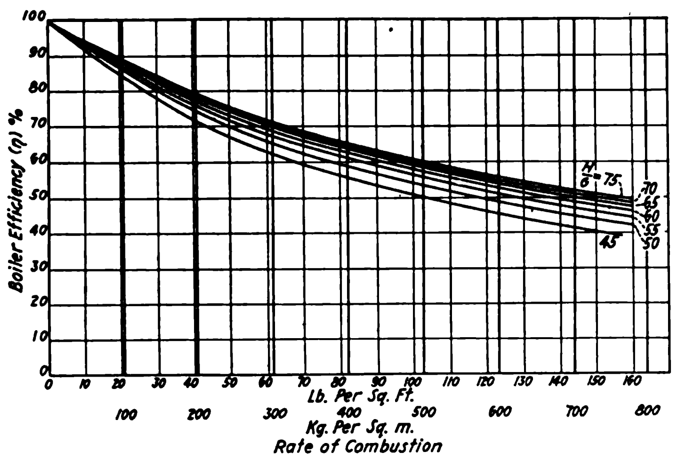


Fig. 4—Relation of Boiler Efficiency to the Rate of Combustion

new formula for mechanical efficiency has been developed as follows:

$$E = 100 - \sqrt{\left(\frac{370}{c}\right)^2 + \frac{0.47}{c}(100 - n)^2} \quad \ldots\ldots\ldots\ldots\ldots \quad n < 100$$

$$E = 100 - \frac{370}{c} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 100 \leq n \leq 150$$

$$E = 100 - \sqrt{\left(\frac{370}{c}\right)^2 + \frac{0.47}{c}(n - 150)^2} \quad \ldots\ldots\ldots\ldots\ldots \quad n > 150$$

where E is the mechanical efficiency, c is the cut-off in per cent and n is the number of revolutions per minute of the

sistance which was estimated by the following formula:

$w = 2.2 \quad 0.015\ v$ kg. per metric ton.
where v is the speed in km. per hour.

or nearly

$w = 5 \quad 0.054\ V$ lb. per long ton,
where V is the speed in miles per hour.

This gives about the same values as those given by Frank's formula, although his formula involves the terms v instead of v^2.

Mean Effective Pressure and Steam Consumption

To calculate the tractive effort of a locomotive by applying the mechanical efficiency, it is necessary to determine the

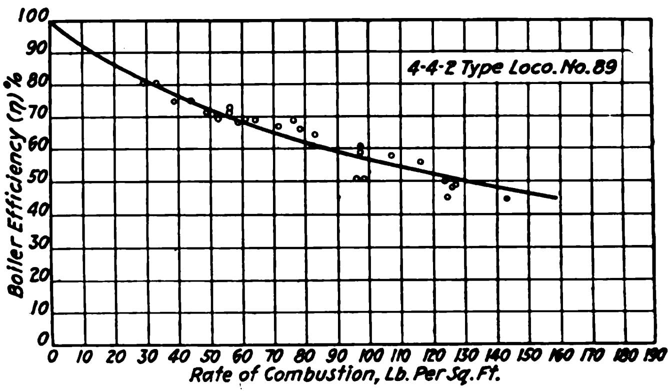


Fig. 5—Boiler Efficiency Curve for an Atlantic Type Locomotive

mean effective pressure and the steam consumption with reference to cut-off and the number of revolutions of the driving wheels.

From the test results which form the basis of this investigation, the mean effective pressures, expressed in the form of ratios to the boiler pressure, correspond to several cut-offs and to succeeding increasing driving wheel revolutions per minute. These are represented by fair curves in Fig. 2.

Similarly the curve of the steam consumption per indicated horse power hour correspond to several cut-offs and to a succeeding greater number of driving wheel revolutions which are shown in Fig. 3. The test results pertaining to steam consumption did not in themselves locate very clearly the steam consumption curves, but a comparative study of all the curves drawn for each set of conditions seemed to consistently support the arrangement of such curves as shown in Fig.

3. They are applicable only for superheated steam locomotives because all of the data used was obtained from the locomotives which were superheated.

Evaporative Power of the Boiler

The evaporative power of the boiler is also required for the calculation of the tractive force. Though there are several formulæ pertaining to the evaporation of locomotive boilers, such as those of Köchy, Strahl and Goss, the author

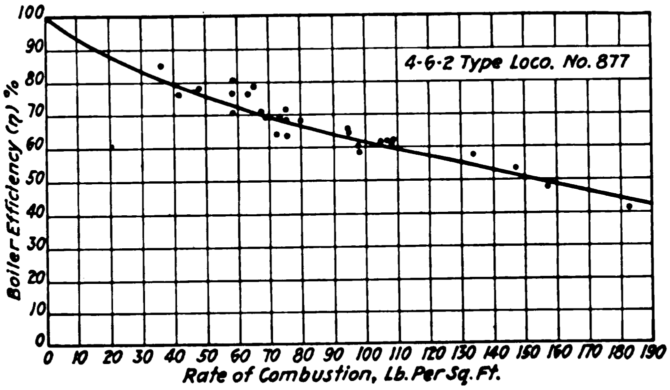


Fig. 6—Boiler Efficiency Curve for a Pacific Type Locomotive

is of the opinion, that the following theoretical formula constitutes a better expression for it:

$$Q = \frac{B\,G\,W\,Z}{h}$$

where Q = the evaporation per hour,
B = the rate of combustion,
G = the grate area,
W = the heat value of the coal used,
Z = the boiler efficiency,
h = the heat quantity required for the production of a unit weight of steam.

To ascertain the boiler efficiency, results from the Pennsylvania Railroad testing plant, Altoona, Pa., were plotted with reference to the rate of combustion and an empirical formula was developed as follows:

$$Z = \frac{1}{1 + B\left(0.0012 + 3{,}300\left(\frac{G_s}{H}\right)\right)}$$

where B is expressed in kg. per sq. meter.

$$Z = \frac{1}{1 + B'\left(0.006 + 16{,}000\left(\frac{G_s}{H}\right)\right)}$$

where B' is expressed in lbs. per sq. ft.

General curves of the boiler efficiency were plotted from the above formula and are shown in Fig. 4. In the case of some of the locomotives tested at Altoona the boiler efficiencies calculated by these formulas are shown by curves in Figs. 5 to 7 together with the test results actually obtained, which are also plotted. These formulas for boiler efficiencies are also applicable to superheated steam locomotives.

Boiler efficiencies of saturated steam locomotive boilers can be obtained from these formulæ under the following assumptions: First, that the heat transmitted through the superheater heating surface is about 10 per cent of the total heat transmitted through the total heating surface. This assumption may also be justified from the Altoona testing plant results. Second, the superheater heating surface is about 30 per cent of the evaporative heating surface. This may be safely assumed as the common practice in up-to-date locomotive construction. The formula then becomes

$$Z = \frac{1}{1 + B\left(0.0012 + 1{,}750\left(\frac{G_s}{H}\right)\right)}$$

Where B is expressed in kg. per sq. meter.

The boiler efficiencies of the consolidation type locomotives tested at Illinois University is somewhat lower than that represented by this formula. While those of the American type locomotive tested by Sanzin of the Austrian Railways are higher, indicating therefor the equity of the author's faith in these boiler efficiency formula.

Tractive Force

The tractive force of a locomotive at slow speed is limited by the adhesive weight or by the maximum cylinder tractive effort. It is also limited by the boiler capacity when the speed is increased beyond a certain limit. The tractive force here considered is limited only by the latter conditions. Since the mean effective pressure may be determined when the speed and cut-off are known, the indicated horse power corresponding to various cut-offs can be calculated for any speed. The steam consumption per indicated horse power hour being also known or determinable, the total steam consumption corresponding to various cut-offs and speeds can also be calculated. On the other hand, the total evaporation of the boiler may be found from the formula given above, so that the longest cut-off for which the boiler capacity is able to meet the demands for steam at the various speeds may be determined. The mean effective pressure may be determined for each speed and for the longest cut-off, for which the boiler can supply the necessary steam, and the indicated tractive force may be calculated. This indicated tractive force multiplied by the mechanical efficiency corresponding to the speed and the cut-off, is the effective tractive force for the given speed. Then, by subtracting the rolling stock resistance from the effective tractive force, we may obtain the tractive force available at the drawbar.

The Computing Chart

The calculation of the tractive force according to the methods explained in the preceding paragraph is rather

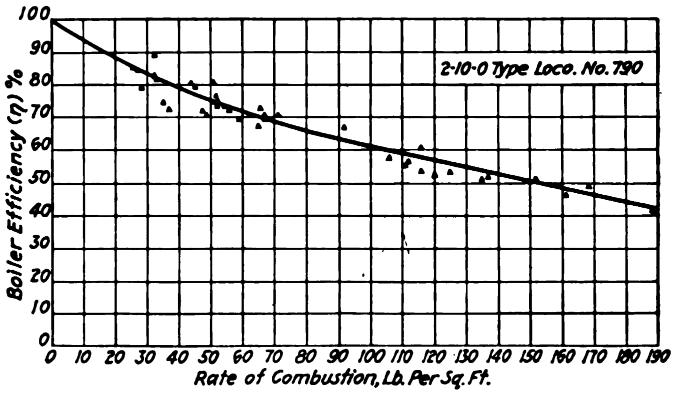


Fig. 7—Boiler Efficiency Curve for a Decapod Type Locomotive

tedious, but by the aid of the computing chart as shown in Fig. 8, the effective tractive force of superheated steam locomotives may be easily obtained with a minimum amount of calculation. The chart is based upon a combustion rate of 113 lb. per sq. ft. of grate area and coal of 12,600 B.T.U. per lb. To use this chart the following constants should be calculated for the particular locomotive under consideration:

$$\frac{\text{Grate area sq. ft. or sq. in.}}{\text{Cylinder volume (one cyl. cu. ft. or cu. in.)}} = \frac{G}{J}$$

$$\frac{\text{Total heating surface (fire side)}}{\text{Grate area}} \;\ldots\ldots\ldots\ldots = \frac{H}{G}$$

$$\frac{\text{Cylinder dia. in.} \times \text{stroke, ft. or in.}}{\text{Dia. of driver, ft.}} \;\ldots\ldots\ldots = \frac{d^2 l}{D}$$

The method of procedure is as follows: Locate the value of G/J on the horizontal scale of the chart. Follow upwards along the vertical line representing the value of G/J, until

the line which represents the proper H/G ratio is intersected. Now consider a horizontal line drawn through the point at intersection just located. Locate the intersection of this horizontal line with the line which represents, in the lower portion of the chart, the proper value of n. Trace the vertical line passing through this intersection point upwards until the proper n line of the same value is again encountered in the upper portion of the chart. Follow the horizontal line through the point of intersection last located to the point where the proper $\frac{d^2l}{D}$ line is cut and read from the scale at the top of the chart the desired effective tractive force. This will apply to the value of n which has been selected and used. The effective tractive force may likewise be obtained for as many other values of n as the various purposes to be served may require.

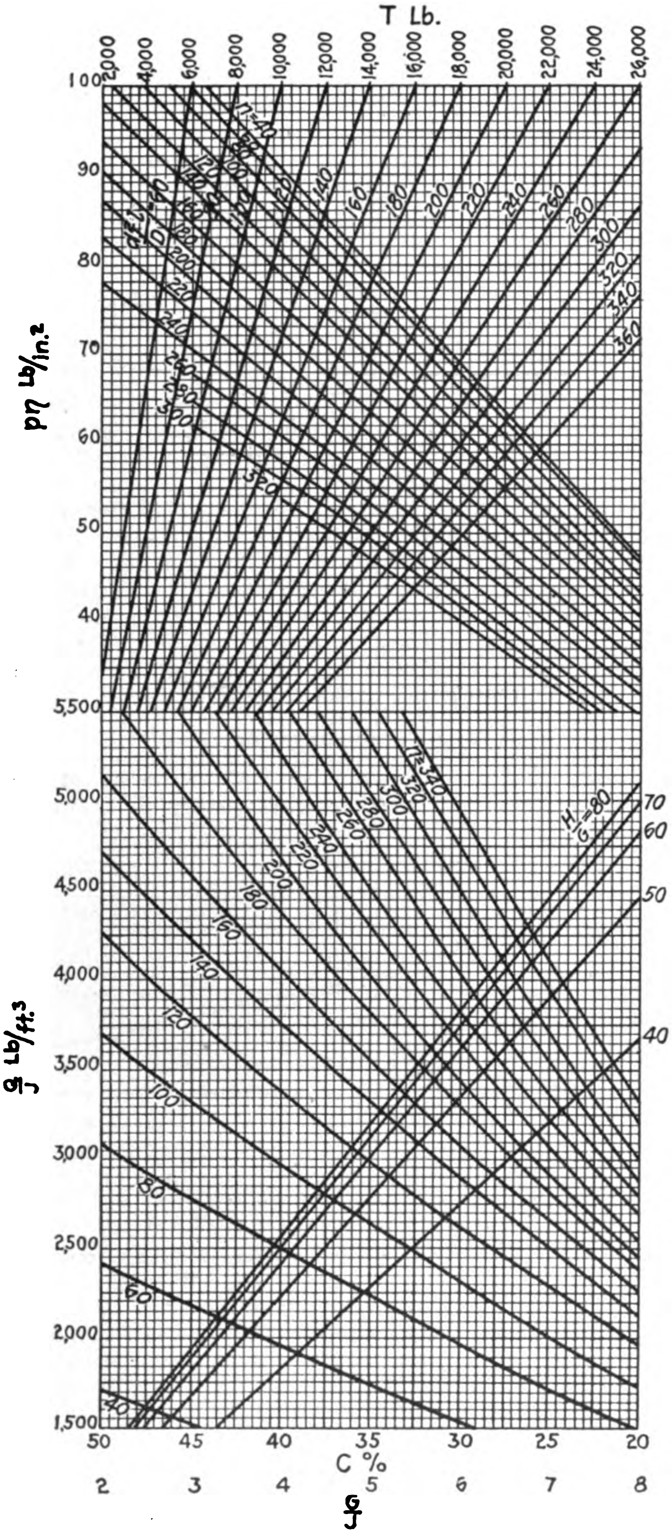


Fig. 8—Computing Chart for Calculating the Tractive Force

An example showing the application of the chart is given as follows: It is desired to find the tractive force of the following two locomotives, namely, a 4-4-2 and 2-8-2 type similar to the E6s and L1s classes of the Pennsylvania Railroad respectively. The necessary data is listed as follows:

Cylinder	23½ in. x 30 in.	27 in. x 30 in.
Diameter of driving wheel	80 in.	62 in.
Boiler pressure, lb. sq. in.	205	205
Grate area, sq. ft.	55.70	70
Total heating surface, sq. ft.	3,406	4,848
Adhesive weight, lb.	133,100	235,800
Total weight, lb.	240,000	315,600
G/J	7.42	7.05
H/G	61.0	69.1
d^2 l/D	207	365

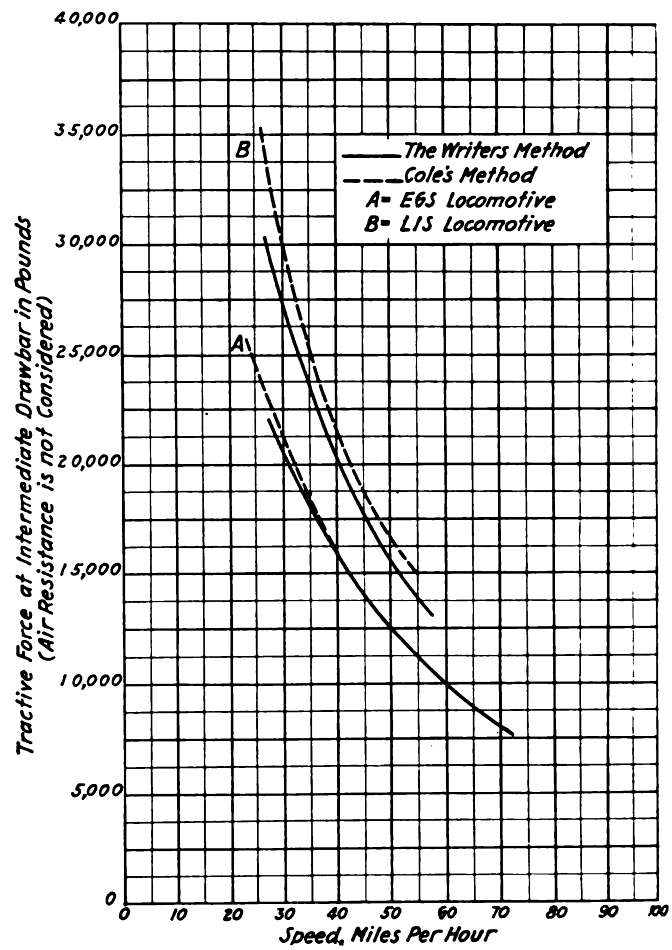


Fig. 9—Tractive Force Curve Calculated by Cole's Speed-Factor Method

We have determined from the chart as the effective tractive force at various speeds, the following values:

n	E6s	L1s
140	19,600	.....
180	15,600	26,000
220	12,800	21,600
260	10,500	18,000
300	8,600	15,000

The tractive force can be obtained by subtracting the rolling stock frictional resistance calculated by the formula given in a preceding paragraph from the above effective efforts. These results are shown as follows:

	Class E6s			L1s		
Revolutions per min.	Effective tractive force	Rolling stock frictional resistance	Tractive force at (a)	Effective tractive force	Rolling stock frictional resistance	Tractive force at (a)
140	19,600	730	18,870	.....	....	.....
180	15,600	780	14,820	26,000	960	25,040
220	12,800	840	11,960	21,000	1,010	19,990
260	10,500	890	9,610	18,000	1,070	16,930
300	8,800	950	7,850	15,000	1,120	13,880

The tractive efforts of the two locomotives were also calculated by Cole's speed-factor method and the results were plotted in Fig. 9. The boiler of the L1s locomotive is of 96 per cent capacity according to the the grate area formula used by the American Locomotive Company. However, the calculations represented in Fig. 9 were made upon the assumption that the boiler was of 100 per cent capacity. Comparing the curves, we find that the tractive force calculated from the computing chart are somewhat lower than those given by the speed-factor method in case of the L1s locomotive, while they practically coincide in case of the E6s locomotive.

From the theoretical point of view there ought to be some differences between the tractive force calculated by the two methods. According to the practice of the American Locomotive Company, the rate of combustion is assumed to be 120 lb. per sq. ft. per hour, and the heat value of the coal is taken as 14,000 B.T.U. per lb., while, in the arrangement of the computing chart, both these factors were assigned smaller values.

Conclusion

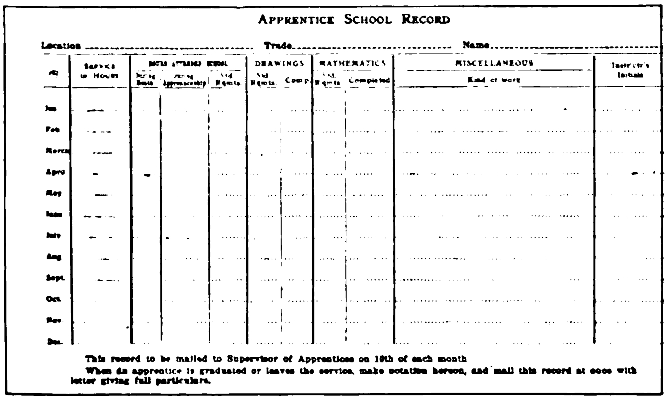
In the preceding paragraphs it is stated that the locomotive resistance should be partly represented as so many pounds per ton weight and partly as a function of the mechanical efficiency. The formula for mechanical efficiency was developed and a method of calculating the tractive effort by applying the mechanical efficiency was also explained. The results of the calculation according to this method are nearly equal to those calculated by the speed-factor method. From a theoretical point of view, the method of expressing the engine resistance as a function of mechanical efficiency is correct. Moreover, this method of calculation of tractive effort can be applied to a locomotive whose boiler capacity is less than 100 per cent. This is important, because many locomotives have boiler capacities less than 100 per cent.

Apprenticeship Methods on the Santa Fe*

Boys Protected Against Personal Prejudice; Wholesome Activities Outside the Shop Are Promoted

Part IV

EACH shop on the Santa Fe has what is known as an "Apprentice Board," a committee composed of the general foreman as chairman, the foreman under whom the apprentices work, the apprentice shop instructor, and the apprentice school instructor. This board meets once each month, on a stipulated day and hour, and passes on the fitness of all apprentices and on questions pertaining to the training and handling of apprentices. The fitness of each apprentice is discussed at least once each month during the boy's probationary period, once each six months thereafter, and oftener as occasion arises.


APPRENTICE SCHOOL RECORD

Location .... Trade........ Name........

Drawings | Mathematics | Miscellaneous — Kind of work | Completed

Jan, Feb, March, April, May, June, July, Aug, Sept, Oct, Nov, Dec

This record to be mailed to Supervisor of Apprentices on 10th of each month

When an apprentice is graduated or leaves the service, make notation hereon, and mail this record at once with letter giving full particulars.

Form of the Monthly Report of School Work

Functions of the Apprentice Board

This board is a live, active body, anxious to deal out real justice to all apprentices. Each member has the same authority and each shows the same spirit of fairness and willingness to give each apprentice the best chance or opportunity possible. The personal prejudice of one man or one member of the board is of little consequence, for all members are anxious that each boy, however poor and friendless, be given full justice. Sometimes the board recommends a further trial of a few months. Sometimes it recommends a transfer to some other trade or a different line of work. Sometimes it recommends dismissal. If the board decides that the boy, instead of being fitted to become a mechanic, should be a lawyer, a doctor, or a merchant, the boy is kindly told that he is wasting his time by remaining in the shop, but in such dismissal the boy knows, his parents know, his friends know, and the shop management knows that the partiality or dislike of no one man was responsible for this action.

If the apprentice appears capable of development, but is not taking advantage of his opportunities and not applying himself as he should, he is called before the board, told of his shortcomings, and what is expected of him. If the board finds that the apprentice has not been given sufficient opportunity to prove his fitness, or is not being given a sufficient variety of experience, arrangements are made then and there to change his assignment of work, and give him the needed experience. Sometimes it is advisable to change the boy to a different department of the shop, under a different foreman.

The board is free to discuss any subject pertaining to apprentices. Report of the board's findings and recommendations is made to local authorities and a copy is sent to the supervisor of apprentices. These apprentice board meetings not only guarantee fair treatment and thorough experience for all apprentices, and the weeding out of the unfit, but result in closer co-operation between instructors and foremen, and aid materially in the training of apprentices. Since foremen as well as instructors know they are to be called upon to pass on each apprentice in their charge, they naturally observe the work of these apprentices more closely, studying their strong and weak points and becoming more intensely interested in their welfare. No one feature of the apprentice training system of the Santa Fe is productive of more wholesome results than the proper functioning of these apprentice boards.

Annual Convention of Apprentice Instructors

The general plan of apprentice instruction is uniform at all points on the system. All lesson sheets and supplies and

*This is the concluding article of a series of four describing the details of the apprenticeship methods followed on the Atchison, Topeka & Santa Fe.

instructions pertaining to apprentices are issued through the office of the supervisor of apprentices. In addition to meetings of apprentice boards and frequent conferences of local instructors, all instructors of the system are assembled once each year for a three-day discussion of matters pertaining to the training and development of apprentices. A few officers from other departments, and one or two speakers of national repute, address the instructors at these meetings, but the program of the convention as a whole consists of discussions by the instructors themselves. They talk shop, compare notes and under the guidance of the supervisor of apprentices, study and plan ways and methods of making the apprenticeship work more efficient, more beneficial to the apprentices, and to the company.

By rotating the place of holding these meetings, the instructors are given the opportunity to become familiar with conditions and equipment and methods at different shops and to profit by the methods used by others in similar work. The annual meeting this year was held at Albuquerque, New Mexico, where the newest and most up-to-date shops of the road are located.

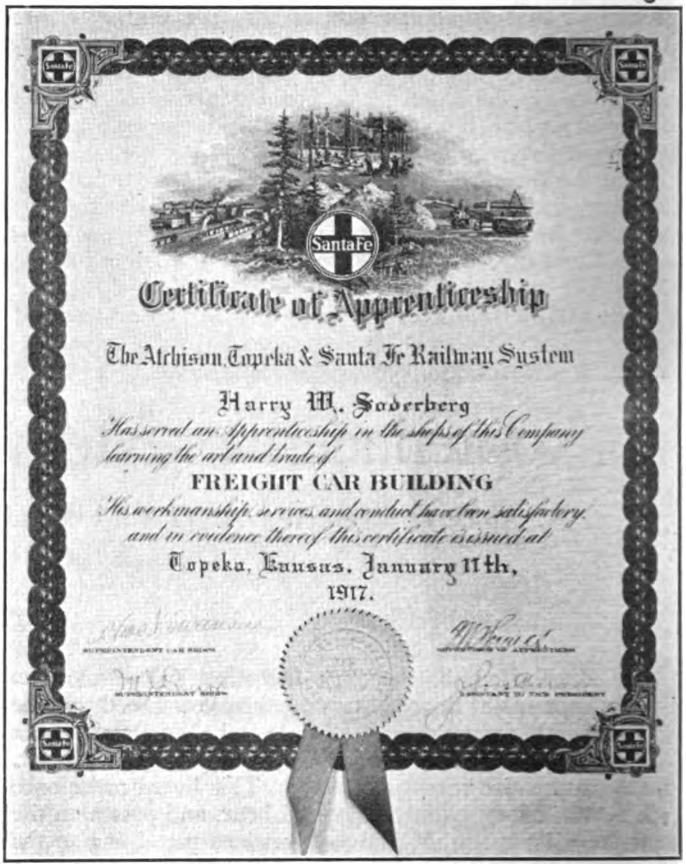
Records of Apprentices and Graduates

A complete record is kept of each apprentice and apprentice graduate. Throughout the four years of apprenticeship the supervisor of apprentices receives monthly reports and maintains in his office records showing the number of hours each apprentice attends school, the number of drawings and problems completed, and what work he has done in the shop. At stated intervals the school and shop instructors are required to fill out a blank showing the personal characteristics of each apprentice. This blank contains 28 subjects on which the instructor must grade each apprentice as being very good, good, medium, or poor. Among the personal characteristics thus considered are his honesty, morality, tact, resourcefulness, foresight, promptness, energy, industry, initiative, persistence, accuracy, appearance, personality, loyalty, executive ability, popularity with authorities and with associates, and other traits indicative of his ability or fitness for promotion. This report contains information of inestimable value, but best of all it makes those furnishing the report study the personal characteristics of these young men most carefully, thereby becoming familiar with their talents and possibilities.

In addition to records of apprentices, a complete record is kept of each graduate, showing the various places he has worked, the positions held, the satisfaction given, and other matters of interest in passing on his placement or promotion.

Diplomas Furnished Graduates

Upon graduation, the apprentice is given a handsome diploma showing that he has served an apprenticeship in his trade in the shops of the company, that he has attended the apprentice school regularly and has completed the required work, and that he has become a skilled mechanic. This diploma is signed by the master mechanic or superintendent of shops, the mechanical superintendent, the supervisor of apprentices, and the assistant to the vice-president in charge of mechanical operation.



Diploma Awarded Freight Carman Apprentices

The apprentice graduate is also given the full journeyman rate of his craft and is given seniority rights from the date of the completion of the first six months, or probationary period, of his apprenticeship. Very few apprentices leave the service upon graduation. There is no reason for their doing so. If they wish to work elsewhere, transfer can generally be arranged to the point at which they desire to work. No other road could treat them better or offer them greater opportunities than are offered them by the road where they served their apprenticeship. The majority realize this and

Page______ **Santa Fe** Shop No.______

Record of______ Employed at______

As______ Apprentice, on______192__ Agreement No.______

Hall 6 23 2M 4542

MONTH	On Pay Roll: Hours on Pay Roll	On Pay Roll: Rate per Hour	Hours on Agreement: Total for Month	Hours on Agreement: Total to Date	REMARKS	MONTH	On Pay Roll: Hours on Pay Roll	On Pay Roll: Rate per Hour	Hours on Agreement: Total for Month	Hours on Agreement: Total to Date	REMARKS
Jan.						Jan.					
Feb.						Feb.					
Mar.						Mar.					
April						April					
May						May					
June						June					
July						July					
Aug.						Aug.					

Card Record Maintained in the Office of Supervisor of Apprentices for Each Apprentice, Showing a Complete Transcript of His Service, Including Transfers

have stayed with the road which gave them their training. Those who have left the service have made good elsewhere, many holding official positions. At least half a dozen have organized and are now in charge of similar apprenticeship systems on other railroads.

A Championship Apprentice Football Team

Apprentices Supplied with Tools

No apprentice is hampered nor is his work delayed through lack of shop tools. From the start each is provided with a uniform set of first class hand tools consisting of everything he will need in connection with his work. These tools are sold to apprentices at wholesale prices and on small monthly payments, the company furnishes each apprentice a neat, substantial tool box for their safekeeping. All defective tools are replaced free of charge.

Discipline of Apprentices

Apprentices work under the same rules as other employees of the shop. The general treatment of apprentices on the Santa Fe is a wholesome one—a mixture of parental and military treatment. It is desired that they have the very best time possible while serving their apprenticeship. No one is allowed to swear at an apprentice or in any way to abuse or mistreat him. The apprentice is never used as a matter of convenience nor in any sense as a helper in the shop. He is taught from the very beginning that his trade is the very best possible occupation for him, that he could not have selected any other work for which he is better suited, or which would bring him greater returns. In brief, effort is made to make him happy and contented in his work and loyal to the company giving him his training. The instructors get very close to their apprentices, winning their confidence, and by virtue of their friendship and intimate relations exert a wholesome influence on their conduct both in and out of the shop. It is aimed to make these young men not only first class mechanics but also men of high moral character—upright citizens whose lives will be a blessing to those with whom they come in contact.

Apprentice Clubs

At most points on the system, apprentice clubs have been organized by the apprentices to foster literary, social and athletic activities of the apprentices. Each of these clubs bears the name of some popular mechanical officer, the club generally being designated by the latter's initials. Each club has its constitution and by-laws and its duly elected officers. Regular meetings are held wherein papers are read, or talks made, by the apprentices or others and ample opportunity offered for apprentices to acquire a knowledge of parliamentary practice. Sometimes debates are held on

The Fred C. Fox Trophy Presented by the General Manager to the Best Apprentice Baseball Team and the Winners, The Topeka Team, 1924

shop subjects. The dances given by some of these clubs have become the social events of the community. Many of these clubs have their own orchestras and other musical organizations. One club gets out a monthly paper or bulletin relative to the activities of the club.

All forms of athletics are encouraged by the management. Baseball, football, and basket ball teams from the various clubs compete with each other for division or system championship. An athletic team can be made an important factor among the apprentices of a railroad shop. The success or failure of the team hinges upon organization and team work. Every player's success depends on his ability to work with those around him in an organized body, each helping the other and pulling together for success. Team work counts whether in baseball football, basket ball, or shop work. In looking at an old photograph of the championship baseball team of 1910, it was observed that nearly every member is now holding a supervisory position.

During the past year, an Association of Santa Fe Apprentice Clubs was formed by the apprentices and a meeting of 120 representatives from the various clubs of the system was held at Albuquerque, New Mexico. The program consisted of inspirational talks by officers of the company and others, a basket ball tournament for system championship, a visit to the new Albuquerque shops and many other features of interest and benefit to the apprentices. Rules were adopted governing interclub contests, these stipulating that no apprentice shall be eligible to play on any apprentice team or to take part in any musical or literary organization unless his school and shop work is up to the required standard.

Special Apprentices

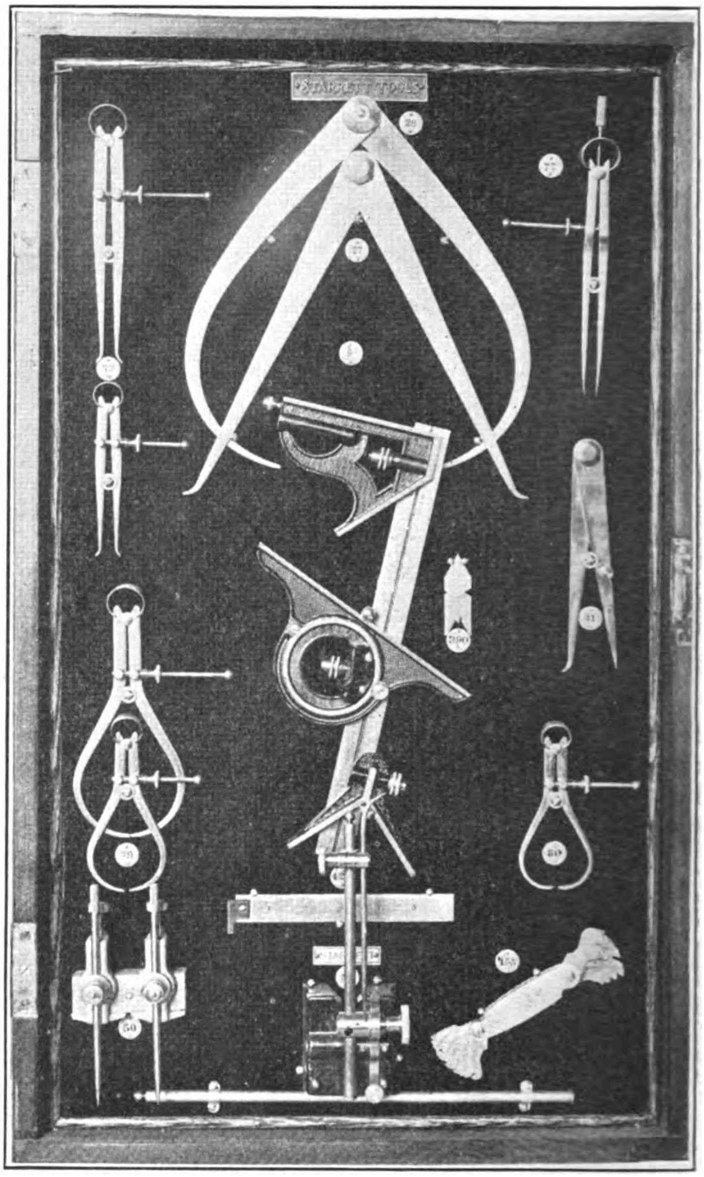
A limited number of special apprentices are employed, one or more being located at each of the division points of the system. These men must have a technical education and are employed only after a personal interview with the supervisor of apprentices or some other officer of the mechanical department. Since they have received sufficient theoretical or technical knowledge while in college, it has been found best to confine their three-year course to actual shop work, a thorough grounding in practical work being necessary to train them for applying the technical knowledge gained in college. Unless supplemented by practical experience, their technical knowledge is of little value in a railroad shop. In order to attract the better class of college men and assist in more careful selection of these special apprentices a limited number of college juniors are employed during the summer months, those showing fitness for special apprenticeships being granted leave of absence in the fall to return to school with the understanding that upon graduation from college they will resume the special apprenticeship course. The three-year special apprenticeship course consists of one year machine work, one year erecting work, and one year of varied work, consisting of four months in the roundhouse, two months in the boiler shop, two months in the freight car shop, two months with the road foreman or traveling engineer, and two months inspection or special work. The purpose of the course is to prepare these men for foremanship or staff duties, but promotions necessarily depend upon the ability and development of the men themselves.

Securing Apprentice Instructors

No difficulty whatever is experienced in securing competent apprentice instructors. They are selected from men employed in the shops, who are familiar with the company's methods and policies and loyal to its interests. The majority of the present instructors are graduates of the apprenticeship courses—young men full of life and ambition, interested in boys and fitted for the job as no men on the outside could possibly be. Since only the best of the graduates are selected for instructorship and the training and experience received as instructors further fits them for promotion, many of them have been advanced to foremanships or other positions of responsibility. In fact the position of apprentice instructor has come to be considered a stepping stone to further advancement.

Developing Foremen

Although the apprentice department was inaugurated to prepare mechanics for the rank and file, and this thought is ever borne in mind, it has also been found a valuable means of training and developing foremen. In fact, 250 graduates of these apprenticeship courses are now holding official positions in the mechanical department, positions of gang foremen, boiler foremen, car foremen and general foremen. Five of these graduates now hold positions of master mechanic and are making good on the job.



Complete Set of Tools for a Machinist Apprentice

All of these are young men with unlimited possibilities awaiting them. There is no telling to what heights some of them may yet climb. Meantime, others are being trained to take their places as they advance. In fact, it is the policy of the Santa Fe to make all promotions from the company's own ranks and to have a man ready for every vacancy that may arise. The foremen who are themselves graduate apprentices, and especially those who have come up through

positions of apprentice instructor, are naturally interested in the welfare of apprentices, gladly lending their co-operation and assistance in every movement having for its object the training and advancement of the apprentices. Likewise the apprentices and apprentice graduates do everything in their power to assist one of their number in making good when he is promoted. After all, the duties of a foreman are largely those of an instructor.

Results Accomplished

It is impossible to measure fully the results which have been accomplished by the Santa Fe through its apprenticeship system. First, there are the skilled mechanics who have been graduated and are now working in the company's shops. These mechanics have no superiors anywhere. Certainly no

Personal Characteristics of

....

....

(Please fill out personally, without assistance or knowledge of any other person, indicating with check mark in column. Mail direct to Supervisor of Apprentices, Topeka.)

	Very Good	Good	Medium	Poor
Education				
Special knowledge				
Experience				
Honesty				
Morality				
Temperance				
Tact				
Resource				
Reliance				
Foresight				
Appearance				
Memory				
Energy				
Industry				
Initiative				
Persistence				
Assertiveness				
Discipline				
Promptness				
Accuracy				
Personality				
Loyalty				
Executive ability				
Shop work				
School work				
Popularity with authorities				
Popularity with associates				
Is he making good?				

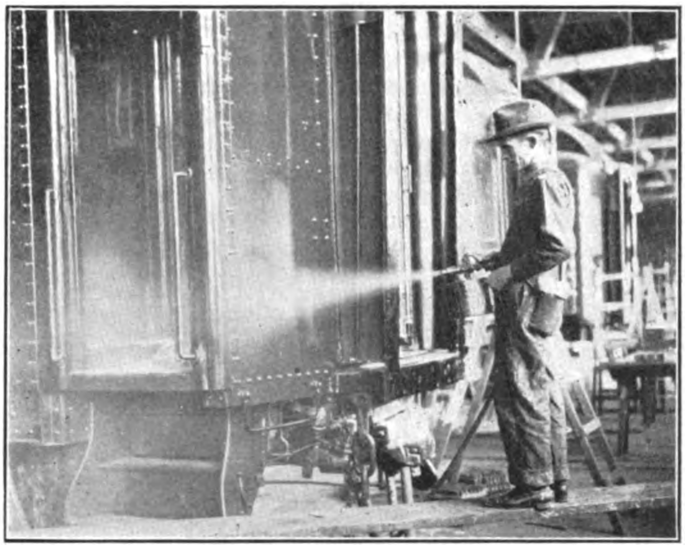
Date........................ .... Apprentice Instructor.

Form on Which the Personal Characteristics of Each Apprentice Are Rated for Report to the Supervisor of Apprentices

others would be so well suited to the road's particular needs. Then there are the promoted graduates, the 250 young men now holding official positions and as many others who are being made ready to take their places as they are advanced to positions of greater responsibility, all young men in the prime of life, with a lifetime of usefulness and service ahead of them.

Mention should be made of the work of the shop instructors. In addition to their duties of instruction, they are ever ready to assist the foremen and are able to relieve them during temporary absences. These men are particularly good material for selection to permanent positions as foremen. Without the shop instructors there would be need for greater supervision in most of the shops. The salary of the shop instructor is not considered as an extra expense. Likewise with the school instructors. Were it not for them, someone else would have to be employed to do the shop drafting and other work performed by them. In addition to instruction in the school room, the school instructor looks after all shop drawing and sketching and all blue prints. He is frequently the only technical man around the plant and as such is a very valuable assistant to the master mechanic or superintendent of shops.

Second only to the training and development of skilled mechanics and to the training and recruiting of foremen, perhaps the most visible result of the apprentice training system is the additional output in work performed by apprentices. Little mention is made of this, for it is always considered of less importance than the ultimate output in skilled mechanics for the future. But it must be remembered these apprentice boys are not only taught correct and up-to-date methods but also that time is just as important as materials. Moreover, a young men can excel an older man in a baseball game, or in any form of athletics, or in any contest requiring quickness of mind or of muscle. He is also more desirous of surpassing or outdoing the other fellow than are those of older years. So it is not to be wondered at that when given



Helper Apprentice Receiving Experience in Modern Method of Varnishing Coaches

competent instruction and incentive, he can turn out a large amount of work, often excelling the older mechanic.

The instruction of apprentices also has a wholesome effect upon the other men in the shop. They are more anxious to use up-to-date methods to keep these younger boys from surpassing them. Moreover, the considerate treatment accorded the apprentices has had a wholesome effect on the entire shop body. The good feeling has been contagious and now permeates the other departments, making a better esprit de corps throughout the whole shops.

From every point of view, an apprentice training system, such as is conducted on the Santa Fe, is a paying proposition. No better testimonial to its effectiveness could be made than that given by John Purcell, assistant to the vice-president, in his paper before the Mechanical Division, American Railway Association, last year wherein he said: "The training course for our apprentices has become a fixed part of our mechanical organization. From sixteen years' experience in this course of training, we have satisfied ourselves that it is the only method to pursue to keep our railroad supplied with first class mechanics."

Effecting Economy Through Careful Design

The Relation of Equipment Design to Maintenance as Viewed from the Designer's Standpoint

By H. Y. Carpenter

Chief Engineer, Davenport Locomotive Works, Davenport, Iowa

This article—awarded the second prize in the competition on the relation of equipment design to maintenance—points out the opportunities which are presented to the designing engineer to pave the way for economical maintenance by anticipating future requirements and preparing specifications and designs to meet them. In contrast, the first prize article, which was published in July, gave a mechanical operating man's ideas of the effect of design on maintenance.

IF all the rolling stock of a railroad should be scrapped and an entire new lot of equipment purchased to replace it, what an opportunity it would be! The handicap under which all railroads now work would be eliminated. Perhaps it would—for a short time at least. But would the new equipment be so nearly perfect and the parts so completely interchangeable that five years later, after additional equipment had been purchased, these same parts would be even more widely interchangeable than when they first appeared on the road? To a small extent they might be, but in many other instances they would be no more so. Were we content not to progress, the extent of interchangeability might be increased as the amount of equipment owned increased but we must make progress so that what seems perfection today may be little short of obsolete ten years hence.

The position of the railroads with regard to equipment is peculiar. They must make use of what they have as long as it can be used economically, and still they must keep abreast of the times and not buy new equipment that is an exact duplicate of a preceding order merely because of the economy afforded by the duplication. In many instances that would be false economy. They can, and many do, endeavor to use as many duplicate parts of equipment received on previous orders as possible, but there are many limitations.

For example, a road that purchased a number of eight-wheelers and moguls in 1890 still has many of these locomotives in branch line service, but they have long since proved unprofitable for main line work. The axles, for instance, are smaller than on any succeeding order. The driving boxes are not interchangeable with those of any later locomotives. But one course is open; boxes suited for these locomotives must be carried in stock at many different points because of the fact that these particular locomotives are widely scattered. Equipment has increased in size considerably since they were built, and no one can say that we have yet reached the limit. What is true of driving boxes is just as true of nearly every other part. Each year it has seemed that the limit in size and refinement has been reached, but each year last year's ideas must be revised.

It is out of the question to scrap the present equipment and start anew; the only course open is to make the most of what we have and endeavor to make each future order more nearly ideal. That ideal is elusive; the new equipment must fill the actual needs of the present and the anticipated needs of the future, at the same time using all possible parts that are interchangeable with those on existing equipment. These are more or less opposing conditions, and to make matters worse it often happens that the new equipment is so urgently needed that there is little or no time to give the matter the careful consideration it deserves before placing the order.

Consider the Builders' Viewpoint

One of several ways of purchasing new equipment which will have a decided bearing on the matter of economical design may be followed. The builder has no time to investigate conditions on the road purchasing the equipment; he has his hands full meeting the specifications and the delivery date. If he can use a driving box that has been used on locomotives for some other road for which he has the necessary patterns, but which may not interchange with any box on the purchasing road, it is to his advantage to do so. The fact that the purchasing road will have another driving box to add to its already long list of boxes that must be carried in stock at many different points on its line is not a matter of much concern to the builder. He was not bound by contract or specifications to use any particular driving box and the one used was subject to no criticism because of faulty design. The specifications have been met and a satisfactory piece of equipment delivered; satisfactory perhaps in every way but one. Practically all of its parts differ from those of any equipment on the purchasing road, with but one inevitable result increased stocks must be carried and repairs are certain to be delayed.

Another serious mistake is never to be prepared for an order for new equipment. Usually when the order for equipment is placed the operating department is more than ready to put it into service. There is no time available to go over the design in detail. Furthermore, the new equipment may be specified to differ materially from any the road then has in service. Specifications must be rushed out and an order placed immediately, for early delivery is of paramount importance. As in the preceding case, the builder does his best, and delivers equipment wherein many parts could have been used that were interchangeable with other equipment on the road, but were not. Hence, while giving the operating department the desired relief, repairs when necessary were found to be needlessly delayed and expensive. These are conditions as they have developed many times and to overcome them is the problem.

Anticipate Future Requirements

"Haste makes waste" is a time-worn adage, but it is only too true in the purchase of new equipment. Hastily conceived designs hastily built and delivered may give the operating department quick relief; the locomotives may move

trains over the road economically as far as fuel and water are concerned, but when they come in for repairs, as they must sooner or later, the cost of repairs and the delay in making them is pretty sure to be greater than necessary. Remove the "haste" and anticipate the needs of the future. Let those responsible for the use and repair of equipment inform the mechanical department of any ideas as to changes or improvements—not after the equipment is ordered and it is too late, but at the time the idea comes to mind. Let the mechanical department always be prepared, so that when the word is passed that certain new equipment is to be ordered it will not come as a thunderbolt out of a clear sky.

Preparedness is necessary, tentative designs and specifications incorporating future needs and eliminating errors of the past should be constantly in the course of preparation, never losing sight of the importance of using all parts possible common to existing equipment or, of making parts of one new design common to other new designs. These should be ready for a final consideration when the order is to be placed and not cause any delay. These designs should be complete in every detail and leave nothing for the builder to do but make the parts accordingly. The design has been made where the equipment is to be used, where the needs of the purchasing road are best known, and not under the stress of meeting a certain delivery date so near that it seems next to impossible to meet it.

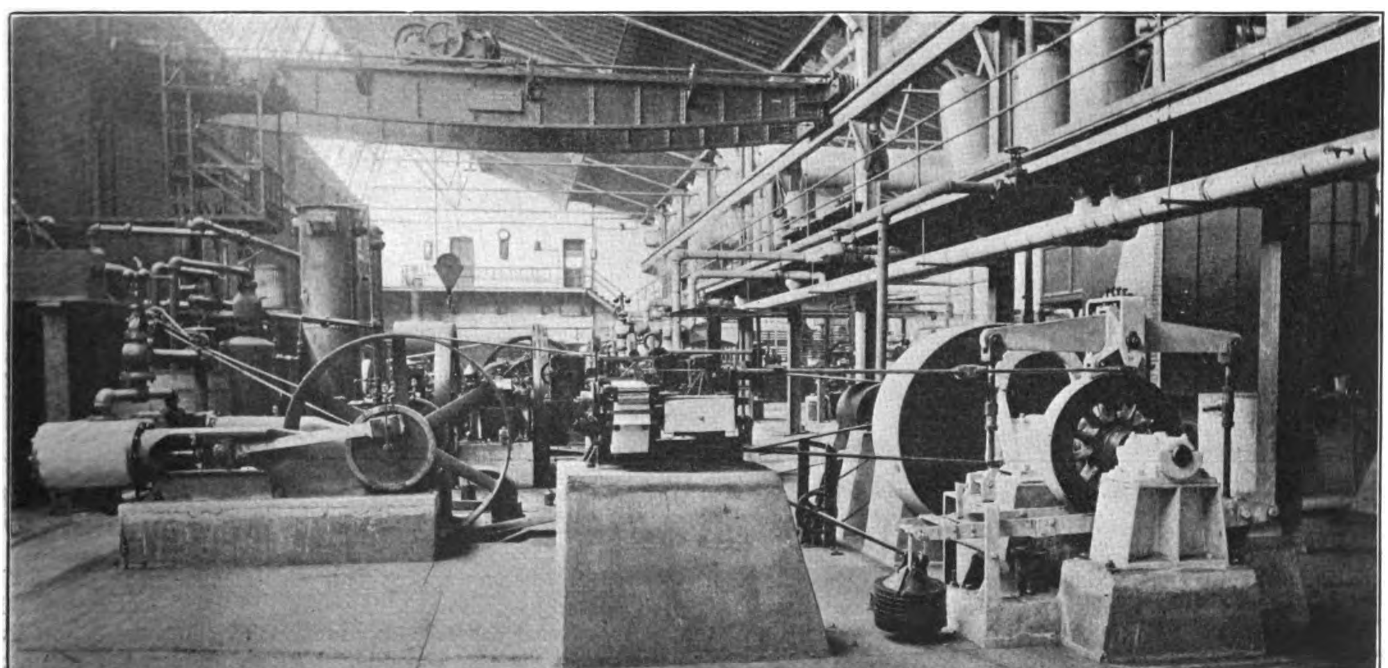
Engineering Department Must Be Progressive

To do this means but one thing: the mechanical engineer's department must be put on the map. It must not be held down to a small number of incompetent men. It must be raised from the almost irresponsible position it occupies on some roads—a place where the shop can get sketches converted into drawings, considered a necessary evil by the management—to one which not only keeps the shops supplied with all the information they require, but also gives the bidder on new equipment a complete specification together with detail drawings of each and every part that is to enter into the design, from which the builder should not be privileged to deviate. The new equipment, when delivered, should be well adapted to the requirements of the purchaser. Provided, however, the interchangeability of parts has not been accomplished then adaptability cannot be complete.

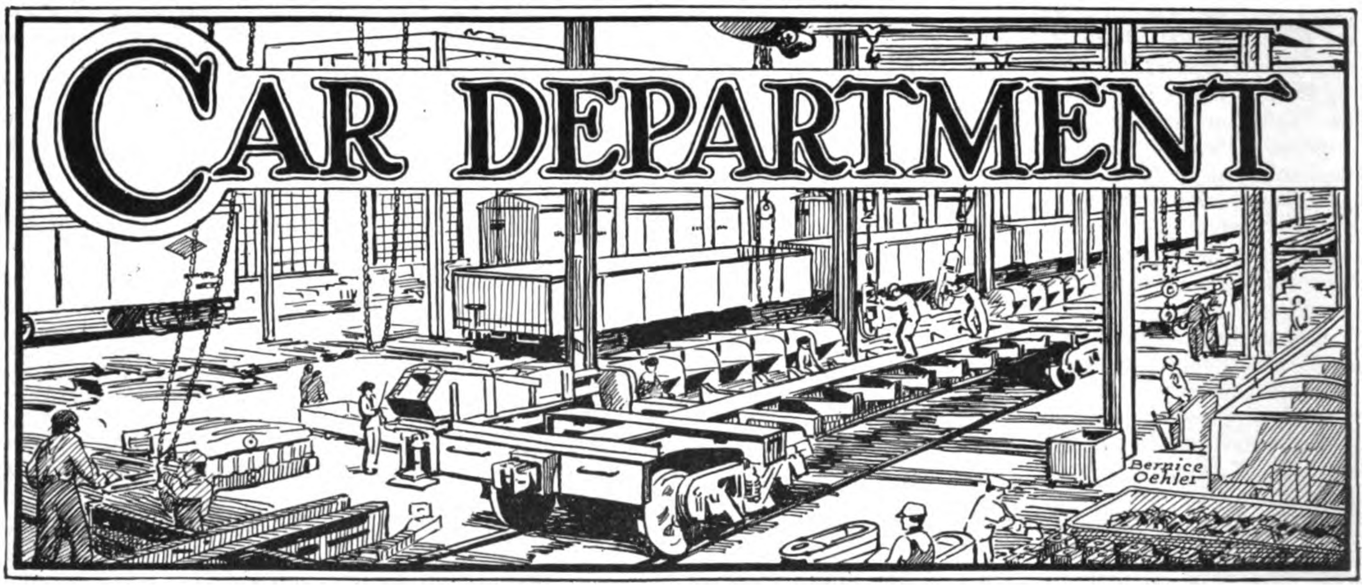
In this no short-sighted policy can be pursued. The mechanical engineer should see that he is informed of the failure of every part of a car or locomotive that was not brought about through accident. A complete file of failure records should always be available. The shortcomings of existing equipment should be brought directly to his attention with a view of correcting them on existing, as well as on new equipment. The management must be willing to give the mechanical engineer such a force as is necessary to meet the requirements and raise his department from a mere drafting room to an engineering department—in fact, as well as in name. It is then up to the mechanical engineer to see that his department is not a place where men who would not last over night with a manufacturing concern can drift aimlessly along, but that it becomes an active part of the organization whose duty it is to design new equipment and to redesign old equipment in such a way that the minimum number of repair parts can be carried in stock and the cost and ease of making repairs are considerations of vital importance at all times. He should see to it that the department is alert and that a broad program for the future is constantly being studied and improved upon.

Conclusion

In this way, with the equipment designed in detail—not in general—where it is to be used, maximum interchangeability will be accomplished permitting parts to be manufactured in large quantities with a resultant saving due to quantity production. As no road can disregard its existing equipment, such a course, if adopted, would not be of immediate and conspicuous benefit. But there should be an ever-increasing improvement, which would become more apparent as time goes on. While impossible to trace the direct saving through the larger and more efficient force under the mechanical engineer, it is certain that the saving effected would nearly, if not completely, offset the additional expense charged to an increased office force.



University of Illinois Laboratory Used for Testing Wheels and Brake Shoes



Self-Propelled Passenger Car on N. Y., N. H. & H.

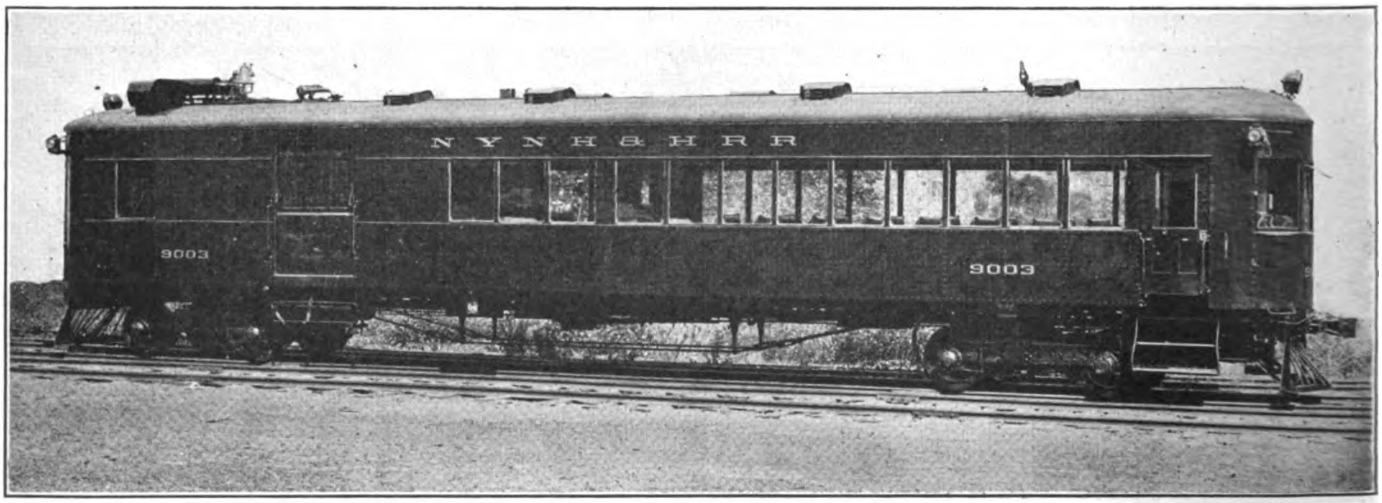
A 150-hp. Ricardo Engine Operates a Pump Which Supplies Oil to Two Hydraulic Motors

THE New York, New Haven & Hartford has had in operation for some time a combination passenger and baggage unit car which is propelled by a 150-hp. Ricardo engine, through a transmission consisting of one Size 50, Universal hydraulic variable-delivery pump, supplying oil to two Size 20, Universal hydraulic variable-speed motors, one mounted on each truck frame. The actual light weight of the entire car, including engine and transmission, is 52,800 lb.

The car body has an overall length of 57 ft. 8 in. and is designed to carry approximately one ton of baggage and will seat 60 passengers, with room for 15 persons in the smoking compartment and 45 persons in the main passenger compartment. The maximum speed of the car on a straight, level track when loaded is 40 m.p.h. Provision is made for double-end control.

The Driving Mechanism

The Ricardo engine is rated at 150 hp. when running at 1,200 r.p.m. However, in this installation the speed is being limited to 950 r.p.m., with a consequent limitation in power. In addition to driving the pump unit, the engine drives a jack shaft by means of a Whitney silent chain. This jack shaft in turn supplies power to the fan, air compressor and pump for supplying oil to the speed gear control. Gasoline for the engine is carried in two 25-gal. tanks suspended under the floor of the baggage compartment.



A Combination Passenger and Baggage Car Propelled by a Gasoline Engine Through a Transmission Consisting of One Hydraulic Delivery Pump and Two Hydraulic Variable-Speed Motors

The fan has an approximate displacement of 3,500 cu. ft. of free air per min. when running at 610 r.p.m., and it is estimated that it will not require over five horsepower to drive the fan at the above mentioned speed. The fan is mounted forward of the engine and draws air directly from the outside. The air from the fan is blown through a tubular

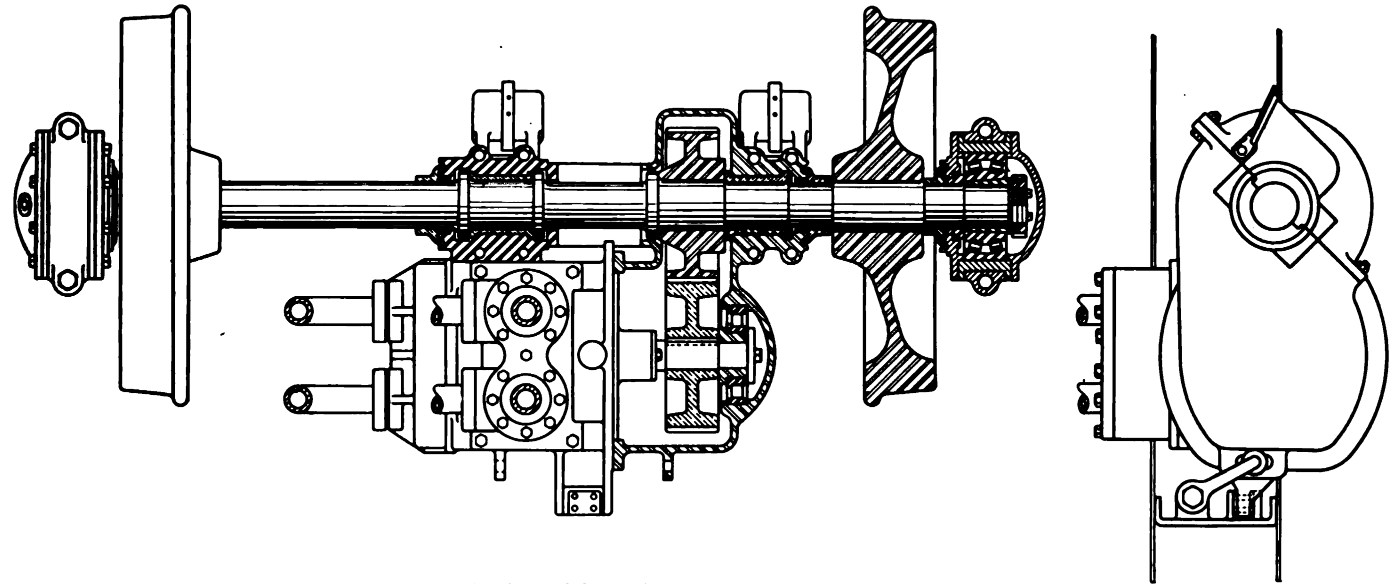
radiator and exhausts through the roof. The cooling water for the engine is circulated through the radiator by means of a circulating water pump, which is mounted as a part of the engine unit.

Air Compressor and Pumping System

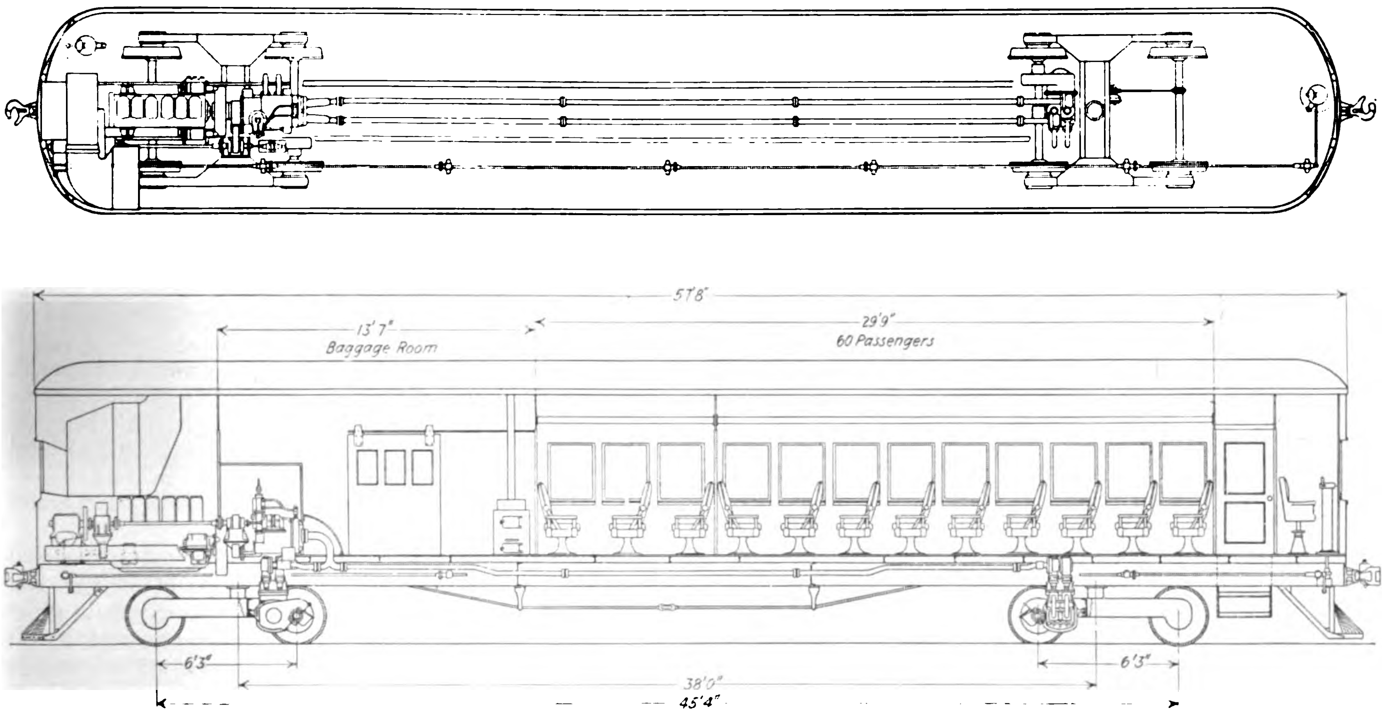
The air compressor is the Westinghouse F-1-B, which has a nominal rating of 15 cu. ft. of free air per min. when operating at 220 r.p.m. against 100 lb. air pressure. However, as only 50 lb. of air pressure is to be carried for this installation, the speed is being put up to 330 r.p.m. and delivery will be about 25 cu. ft. per min. At this pressure it is estimated that the power required will not exceed two horsepower. The air compressor is driven from the jack shaft through a Thermoid flexible coupling.

A Diehl Manufacturing Company's generator is driven from the front end of the engine through a flexible coupling. This generator is shunt wound and delivers 23 amperes at 33 volts when operating at 950 r.p.m. It supplies current for starting, lighting and ignition, and also charges a 32-volt battery.

A Waterbury Gear Company's Size 50, Universal hydraulic, variable-delivery pump is driven from the engine through a double helical gear reduction, ratio 53 to 23, so that when the engine is running at a speed of 950 r.p.m., the pump, or so-called A-end of the transmission, runs at 410 r.p.m. The Waterbury variable speed gear consists of an oil pump designated as the A-end and a hydraulic motor designated as the B-end. Oil from the pump, or A-end, is carried through pipes running just below the floor to the two motors, or B-end. In order to provide for movement of the trucks when the car is going around curves, or when encountering obstacles on the rails, two ball joints and one sliding joint are placed in each pipe line. Each of the ball joints has sufficient swing to allow for a movement of approximately 15 deg. each way. This movement is somewhat in excess of what will be encountered when the car is on a curve having a 100-ft. radius. The sliding joints are placed in vertical planes and



Method of Mounting the Motors on the Axles



Plan and Elevation of Gasoline-Hydraulic Passenger Car

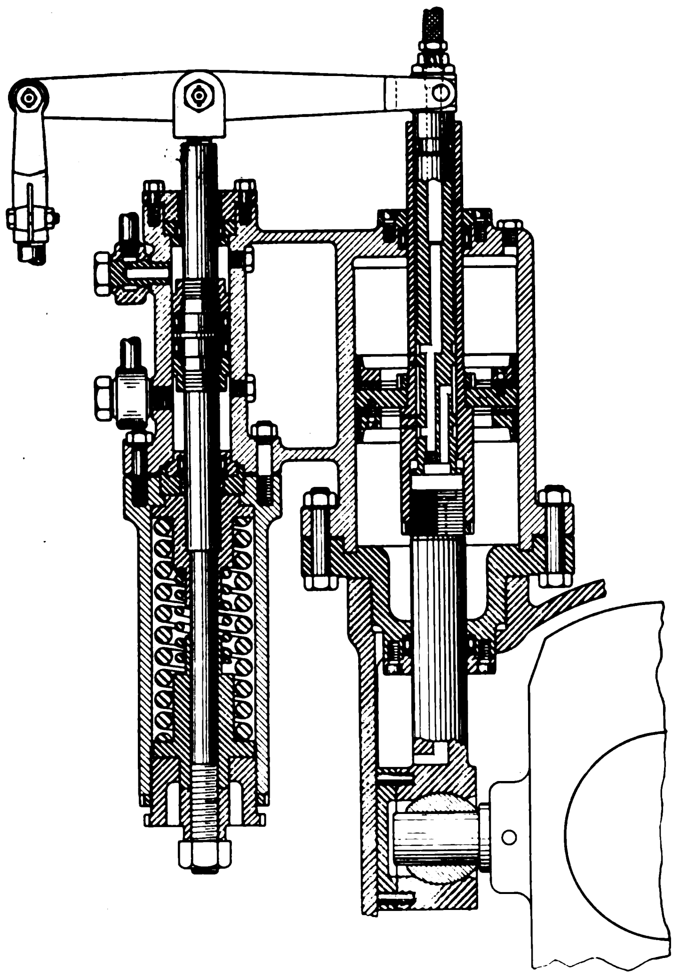
take care of the vertical movement of the trucks when passing over obstructions on the rails, or the movement of the car body when the springs are flexed.

The Motor Units Are Suspended on the Axles

The motor units are suspended on the axles by a method similar to that employed in suspending electric motors on electric locomotives. The lugs for the bearings are cast integral with the case of the motor unit. On the opposite side from the axle a suspension lug is provided which is also cast integral with the case and carries a hardened steel top and bottom plate. These plates are held between other hardened steel plates attached to the truck transom. This arrangement provides for misalinement of the axle relative to the transom and also allows for a slight movement of the axles up and down due to the flexing of the springs.

On each side of this suspension lug are two lugs engaging links, which in turn are attached to the truck transom. These auxiliary lugs only come into action in case of failure of the main suspension lug and prevent the motor from dropping to the track if the main suspension lug should fail.

Gearing is used between the motor shaft and the car axle. The maximum speed of the motor unit is 515 r.p.m. At this

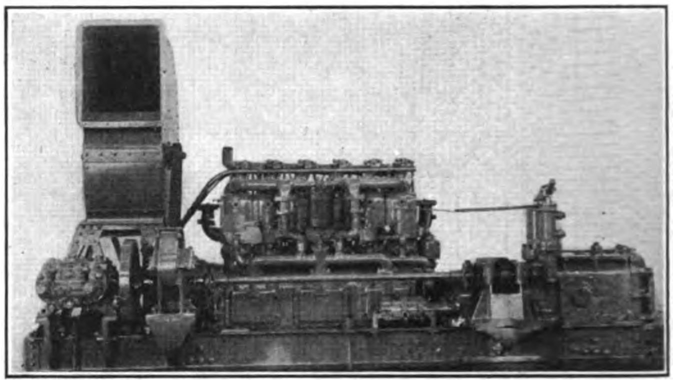


The Control Mechanism for the Universal Hydraulic Pump

speed the car axle will run at 450 r.p.m. As the car wheels are 30 in. in diameter, this is equivalent to a speed of 40 m.p.h. The housing for these gears is cast integral with the motor end case.

The engine, pump unit, fan, generator, air compressor and servo-motor oil pump are all mounted on a structural steel sub-base. This sub-base is insulated by means of rubber pads from the main frames of the car. This prevents the telephoning of vibration and noise back into the passenger compartments. The rubber insulating pads are protected from oil and grease to prevent deterioration of the rubber.

Ventilation of the engine compartment is effected at the will of the driver by opening a gate into the fan casing so that part of the air taken by the fan will be drawn through the engine compartment. The car is heated by a Peter Smith Company's No. 2 P. O. heater, complete with motor wound for 32 volts and blower for forced ventilation, located in the baggage compartment of the car. The car is supplied with



This 150 hp. Ricardo Engine Drives the Pump Unit Air Fan and Air Compressor

standard air brake equipment and also with hand-operated brakes. The main axle journals of the car are mounted in S. K. F. standard roller bearings.

Flexibility of Control

With the Universal hydraulic variable-speed transmission all variations in the speed of the car, as well as reversal of direction of movement, is effected in the hydraulic variable delivery pump. At all speeds of the car from full speed in one direction to full speed in the opposite, the engine runs at constant speed and in one direction only. The control of the Universal hydraulic delivery pump is effected by means of a servo-motor. This consists of a pressure operated piston acting directly on the control shaft of the pump. Oil is admitted to either side of this piston at the will of the operator by a small control valve. Movement of the control valve is effected by means of links and an oscillating shaft which runs the entire length of the car. The movement, through approximately 90 deg. of a small hand lever in either driving compartment oscillates this shaft through approximately 30 deg. This is sufficient to move the control valve from neutral to full stroke in the opposite direction, with corresponding reversal in direction of movement of the car. The control valve is incorporated in the servo-motor piston, and a slight movement of the valve uncovers a port in this piston, allowing pressure oil to flow into the main servo-motor compartment, moving the piston in the same direction the valve has been moved. When the piston moves an amount equal to the movement of the valve, the port is closed, shutting off the flow of oil and bringing the control shaft of the speed gear to rest. In this position the control shaft is oil locked until the control valve is again moved. This method of control is as positive as a screw and nut, but relieves the operator of practically all effort.

The oscillating control shaft above mentioned is mounted in ball bearing pillow blocks on the frames of the car, and universal joints are introduced at necessary intervals in order to prevent binding of the shaft in the bearings due to twisting of the car frame. By these means the effort required to move this control shaft is reduced to a minimum.

A pressure control is incorporated in the control system.

This pressure control begins to operate at about 450 lb. oil pressure. As the oil pressure exceeds 450 lb., the stroke on the pump is automatically cut down so that by the time the oil pressure has reached 1,000 lb., the stroke has been reduced to one-fourth of the full stroke. The design of this pressure control is such that at speeds of from about 25 miles up, the horsepower output of the engine is maintained practically constant, and the speed of the car is determined by the oil pressure in such a way that it is impossible to stall or overload the engine on grades. It is also unnecessary for the operator to take any action when approaching a grade, as the pressure control will operate automatically to do what he might do, but in a much more uniform manner.

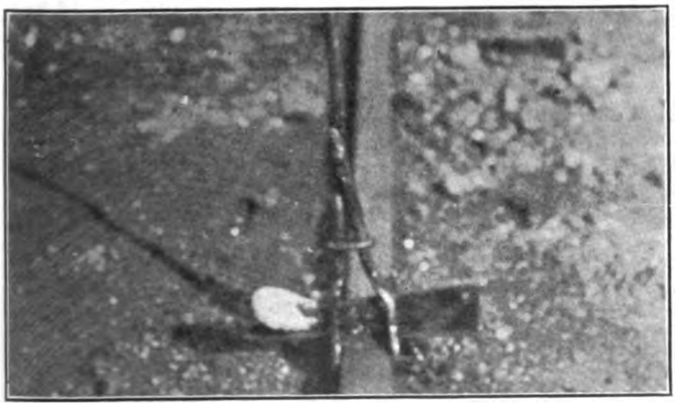
The car wheels have a diameter of 30 in. and the main diameter of the car axle is 3¾ in. This is increased to 3⅞ in. in the motor journals and a shoulder 5½ in. in diameter is provided on each side of the center motor journal in order to take care of the end thrust due to the tendency of the motor to shift on the axle when the car is going around curves. The driving gear on the car axle is a steel forging having a nominal bore of 4 1/16 in. No keys are provided for this gear, but the gear is pressed on to the axle by a pressure of 35 to 45 tons.

Suitable guards and dust rings are provided to prevent dust getting into the gears and main motor journal bearings. Lubrication of the motor journal bearings is provided for by incorporating waste filled oil wells in the journal castings. These oil wells are similar in construction to those used on motor mountings on electric locomotives.

Clamping Device for Attaching Blue Flag to the Rail

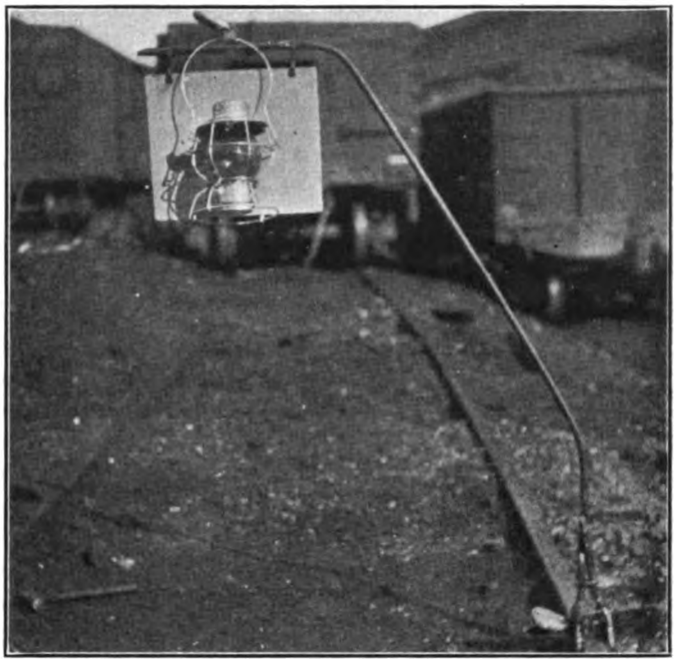
By Charles Nugent
General Car Inspector, Florida East Coast Railway, St. Augustine, Fla.

QUITE often a blue flag attached to a mast which is pointed at the end will fall down when stuck into the ground or track ballast. This is a dangerous condition as a locomotive is liable to be coupled to the cars and moved while the carmen are working under them, due to the fact that the train crew did not have any means of knowing that the cars were being worked on without a man walking the entire length of the train. In order to eliminate any possibility of a flag becoming misplaced or falling down after it has been once placed in position, the clamping arrangement shown in the illustrations has been devised so that the mast of the blue flag can be locked in position on the rail.

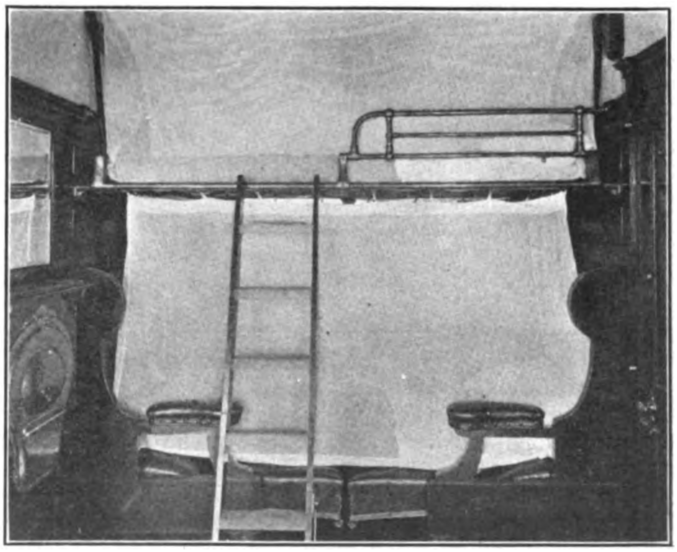


The Clamp Can Be Locked to Any Size Rail

The position in which the signal is held and also the manner in which it is clamped to the rail are shown in the illustrations. The outside jaw is a loose fitting piece and is fastened to the rail by a slip ring and wedge shaped key. The jaws extend under the head of the rail and the wedge shaped key is so constructed as to take up the space on any size rail. After the flag is applied to the rail the slip link is dropped down which fits into notches on the mast, and the outside jaw and the wedge shaped key is thus tightened to the rail so as to hold the mast in a perpendicular position. The key is provided with a slot through which a padlock can be inserted thus preventing the key from being removed by any unauthorized person. This also insures the flag being left in the proper position as it cannot be removed until the lock has been opened and the clamp removed. The mast is made of round wrought iron bar stock of sufficient strength to hold the flag and lantern over the center of the track without sagging.



Showing Lantern Suspended on Mast Over Center of Track



The Berths Used in Sleeping Cars on the Siamese State Railways are Similar to Those Used in the United States

Intelligent Oilers Will Prevent Hot Boxes*

Men Must Be Taught the Importance of Their Job—Eternal Vigilance Is the Price of No Hot Boxes

By Oscar Skegsberg
Assistant Car Foreman

HALF the energy of the average car foreman is utilized in trying to subdue the refractory hot box; the nemesis that haunts his dreams in and out of season. How to stop this perennial epidemic is the problem which every progressive carman has set his heart on solving.

That this will be accomplished in time no one who knows the caliber of the leaders of car work will deny. A great many of the facts of science were built up by the contributions of small items of fact from thousands of unknown investigators. For this reason the writer ventures to set forth the ideas developed by his company for the reduction of the hot box evil, in the hope that it may help some one to form a better plan. He can say, however, without boasting that the number of hot boxes has been reduced about 50 per cent.

This paper was awarded second prize in the hot box prevention competition which closed March 1, 1924. The inspection and maintenance of journal boxes is generally considered by railway officers, as a job that can be assigned to any unskilled laborer. No thought is given to teach the oiler the relation of the contained parts of the box to proper maintenance. He is led to believe that he is performing a menial job and is never encouraged to think further than his dope bucket and packing hook. Consequently, when an epidemic of hot boxes occurs it is traced back to men who do not thoroughly appreciate the importance of proper inspection and maintenance. The writer, realizing the importance of the human phase of this problem, has set forth in a clear and concise manner, how he believes it can be solved.

In the past, as far as my experience goes, it has been the practice of railroads, when in need of car oilers, to hire the first unskilled men who applied for a position with the result that they had men on their payrolls with no qualifications for railroad work, nor any interest in the job except pay day. This resulted in producing indifferent work —a faithful ally of the hot box. It has been stated that it requires neither skill nor knowledge to pack a journal box. I hope to prove that it requires a bit of skill, conscientious work, and a great deal of information to be a successful oiler. I might add that unskilled poking is the cause of half the hot boxes.

The writer has found that the average man is indifferent to his work, not from want of interest, but from lack of the right information. Frequently a new man is hired, taken by the foreman to the yard and curtly informed; "Here's the dope bucket, there's the cars. Go to it." Naturally the man is going to get by as easy as he can. On the other hand, if the foreman takes a little trouble to explain the details of the work, show him how it is done and why it is done, then, as he gradually grows more accustomed to the work, show him the possibilities of the job in new angles of interest, such as conditions about the wheel and journal and what these things indicate, his interest is heightened, his intelligence is challenged, and you have supplied the incentive to do good work.

Of course, this method takes time, but I believe it is justified by the results obtained. The foreman should never allow the interest to lag but should point out the best methods of treating different journal boxes and explain why. He should explain the different mechanical defects about a car that may cause a hot box and why it may cause heating. In this way the oiler develops into the faithful, intelligent workman, so essential for success. He is never at a loss to know what to do and how to do it. Instead of the aimless, monotonous poking of innumerable boxes, he will discover individual characteristics in each box, demanding a variety of treatment and, being interested, will take pride in doing his work well. Only in this way can the hot box problem be solved.

Preparing the Packing

Ordinarily, preparing the packing is a prosaic job, rather disagreeable, and to be finished as soon as possible. To all appearances it is an oily subject, devoid of interest, but the foreman can usually enliven the work by asking a few pertinent questions and start a discussion about the wick action of the waste; how throwing the waste promiscuously in the vat destroys this action; why it is necessary to thoroughly saturate the waste with oil; that one pound of waste will absorb four pints of oil; that oil of a good quality should have body and elasticity, feel smooth to the touch, and stretch out when the thumb and the forefinger are slowly separated and that this elasticity of the oil allows it to adhere to the journal in a thin film or protecting coat against friction between the journal and the brass. Knowledge of wick action will lead the oiler to stir up hard packed boxes to break the glaze.

Proper Packing of a Box

Another operation of equal importance to preparing the waste is the proper packing of the boxes. All the boxes should be thoroughly cleaned and free from grit. This done, the back roll, crescent shaped to fit the contour of the box, is worked carefully back to the extreme rear end of the journal box leaving it in such a position that it does not extend above the center line of the journal. Then spread the packing over the entire mouth of the box, allowing it to overhang outside, and push it evenly back with the packing knife always adding more packing before the final strands are put in the box. In this way all the packing is bound together in one mass. The packing should not extend above the center line of the journal as it increases the chances for waste grabbing.

*Awarded second prize in the competition on hot box prevention which closed March 1, 1924. The paper awarded first prize was published in the August issue of the *Railway Mechanical Engineer*.

Having learned how to prepare the packing and to pack a box properly, the oiler should then be taught not to apply his packing knife indiscriminately to all boxes but to distinguish the condition of each box, the appearance of the wheel, journal box, wedge, brass and the packing. Each tells a story to the practiced eye.

Many able leaders have protested against the needless stirring up of the packing as a useless labor, doing more harm than good. This is good advice as far as it goes, but with one reservation, that the oiler should know the conditions of the journal box that makes the operation a waste of labor. It also has the merit of saving time and avoiding delays to trains. A journal box of this kind can be readily seen at a glance, if the packing is properly adjusted and of the right saturation; if the brass and the wedge is in good order; and if by feeling the journal with the ball of the index finger, a thin film of oil adheres to the finger from the contact it is safe to say that it will reach its destination without causing any trouble.

It must be insisted, however, that the time saved on good boxes should be devoted to those that require attention of which, unfortunately, there are too many. During a cold spell the packing is almost uniformly forced in a hard ball to the front of the journal box. This is fatal to a cool journal. To force it back is useless. If the packing is not frozen too hard it should be disengaged and spread out, then woven uniformly to the back of the journal box and additional waste supplied until there is enough to reach the center line of the journal. If the ball is frozen too hard to work in this way, it should be taken out and the box repacked with fresh packing.

The oiler should always be instructed to take great care in removing pin grease from any box and then to repack it carefully. I may be prejudiced in this matter but when it is realized that the journal attains a considerable temperature before the pin grease comes into action, and that it tends to destroy the wick action of the waste strands by forming a glaze underneath the journal, it is good policy to remove it.

Overpacked Boxes

The number of boxes that are overpacked is surprising. In some cases the brass can scarcely be seen. The sides and end of the journal box are jammed full with perfectly good packing but entirely useless for the purpose intended. This condition must not be allowed to remain if one wishes to avoid hot boxes, for not only is it a continual menace as a waste grabber but, owing to the jammed in packing, is a cause of a glazing underneath the journal. The only remedy is to remove the superfluous packing and readjust the remainder. In this connection it may be well to state that all boxes should be examined to see that no packing is in position to cause a waste grab. Eternal vigilance is the price of no hot boxes.

A feature that will catch the oiler's eye is the scattering of oil over the wheel. Usually this is regarded as an indication of a hot box. Even though the journal is not heating it shows an unhealthy condition. It may be that the packing is dirty and chewed up until it is of the consistency of a black pasty muck. The oil, instead of adhering to the journal, is cast off on the revolving wheel. Obviously, lubrication is impossible and the box must be repacked. If a new brass is noted, this condition may be caused by the spreading of the lining, uneven lined or hard spots in the babbit, lining rough and pitted or there may be nicks, pits or ridges in the journal. These defects easily multiply the number of hot boxes.

Glazed Packing

There is also another source of a great many hot boxes that must not be overlooked; that is, the formation of a hard glaze underneath the journal preventing wick action of the waste and choking off the supply of oil to the journal. On this kind of boxes the intelligent oiler is invaluable. He notices that the packing seems to be good but the oil adhering to the journal is pitchy, black and sticky to the touch or there may be scarcely any oil clinging to journal. In a well lubricated box, the oil appears fresh and of a dark amber color entirely different from the above. At any rate, the adjustment or stirring over of the packing is absolutely necessary. Taking the packing hook the oiler pulls the packing towards him from the sides of the journal, spreading it evenly over the mouth of the box. Then he weaves it back again in the regular manner as if packing a new box. In this way the glaze is broken and the saturated dope is in contact with the journal and the wick action is restored.

Dry Boxes

Another ounce of prevention that is worth while, is the proper handling of boxes that have run dry. Quite a number of these boxes are encountered during a day's work and it will be admitted that these boxes must be replenished somehow with more oil. I am not an advocate of the oil can method as I think it is a loss of good oil and of labor. In the first place, how can a dry box be detected? From my own experience and by experiment, I have found that a good sign of a dry journal is the dry, smooth, shiny appearance of the end surface of the journal, especially around the center punch. This should be handled as follows: The oiler carries in his bucket a small quantity of rich packing to be used for this purpose. He pulls out the packing from both sides of the journal, spreading it out and over hanging the mouth of the box until he has a sufficient vacant space on each side of the journal, then, inserting the rich packing in place of that removed, he weaves it evenly back in one mass as if packing a new box. In this way the rich dope will be in a place where it will do the most good, that is, in direct contact with the journal. The oil is not as liable to run off and spatter the wheel as when it is applied with an oil can.

The mechanical defects of cars that contribute to the causes of hot boxes have been omitted for the reason that these defects have been so thoroughly covered and so ably presented, that anything I could say would be only a feeble echo. Nevertheless, this knowledge is so important that no inspector or oiler can afford to ignore them. Variety is the spice of life or of a job. For this reason I have always brought to the attention of the men any authoritative statement, new or old, that would present their routine work at a new angle and thus arouse their interest by urging them to test it out.

In summing up the requisites for a good box oiler it is essential that he be given an incentive in connection with his work; that he be drilled in the fundamentals of every day routine; that his mind be given something to work on, and that he be made to realize that the study of lubrication is worthy of the keenest minds. If the foreman succeeds in driving these points home to his men he will change his men from dull mechanical plodders to intelligent, conscientious workmen who will take pleasure and pride in their work. After all, it is the personal equation, not the hot boxes, that is the real problem to be met.

THE KANSAS CITY SOUTHERN reports for the first quarter of 1924 only 1 death and 69 reportable accidents among employees as compared with 3 deaths and 110 reportable accidents for the corresponding period of 1923.

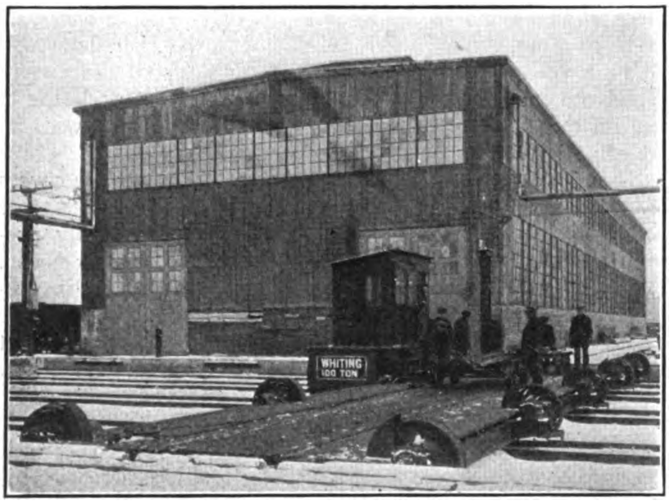
PLANS FOR THE JOINT USE of the Southern Pacific passenger station at Fifth street and Central avenue, Los Angeles, Cal., by the Union Pacific and the Southern Pacific, have been approved by the Railroad Commission of California. In return for permitting the Union Pacific trains to use its station, Southern Pacific freight trains will be routed hereafter on the Union Pacific tracks on the east bank of river at Los Angeles.

New Car Repair Facilities for the D. & R. G. W.

Modern Wood and Steel Car Shops Are Organized with Station to Station Method and Balanced Gangs

Double String of Gondolas Just Out of New Wood Shop Ready for Painting

INCREASED labor rates and the resultant increased cost of freight car maintenance have made the provision of adequate car repair facilities vitally important. The extensive program of the Denver & Rio Grande Western for reconstructing and modernizing its freight car repair facilities throughout the system was referred to in an article in last month's issue and further details will be given in this article. The program calls for identical freight car repair shops for both wood and steel cars at Denver and Salt Lake City. At Salida and Grand Junction old locomotive shops, vacated through the provision of new buildings for locomotive repairs, have been made available for housing the heavy repair freight cars originating at these intermediate terminals and not scheduled for repairs at the main plants.

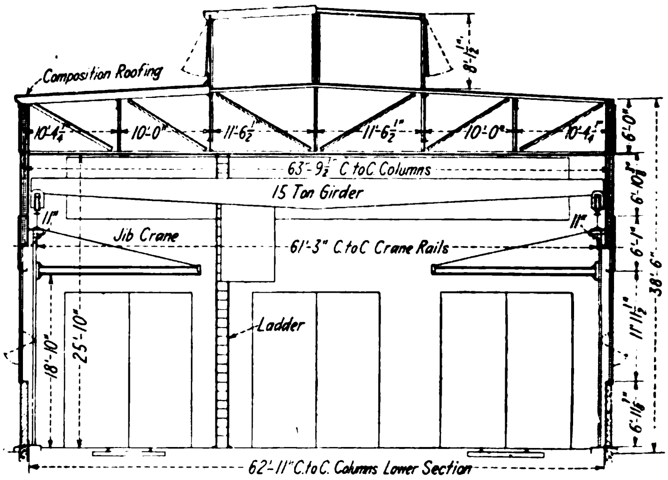


Steel Car Shop Looking North—80-Ft. Whiting Transfer Table in Foreground

Steel Car Shop

The new steel car shop at Denver is a steel building about 65 ft. by 242 ft. in area with brick walls up to the sill height and Robertson process asbestos protective metal covering above. It is served by two tracks which run from the transfer table through the building and out into the car yard at the other end; also by a third stub track between these two which enters the building from the car yard and extends two car lengths inside. Two overhead traveling cranes span the building and serve to lift the car bodies, trucks, steel frames, sheet metal and other heavy material. The through tracks lie well toward the sides of the building, leaving a center aisle directly accessible to both tracks for working space. Jib cranes are provided on every column along the tracks for lifting parts and handling riveters.

The stub track serves as a material track for bringing in materials from outside to be unloaded by the cranes. It is also provided with floor beams and a special design of car straightener for pulling bent steel cars back into shape. The foundation for this car straightener is best shown in the photograph which was taken at night and which also shows the effectiveness of the lighting system employed. The large



Transverse Section Through Steel Car Shop Showing Roof Construction, 15-Ton Travelling Crane and Jib Cranes

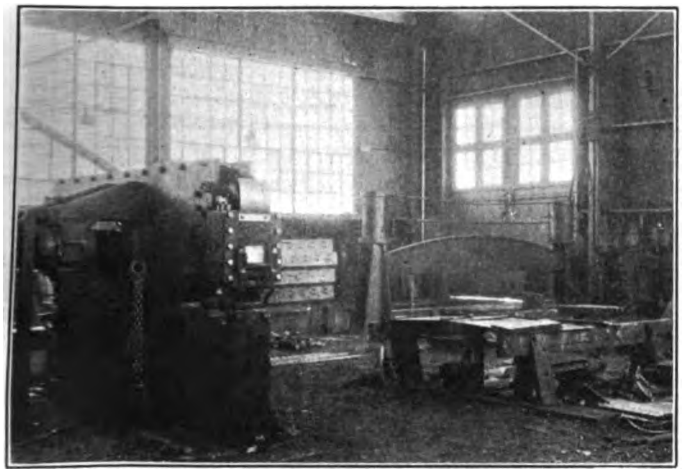
areas of glass in the saw tooth roof construction and side windows give effective illumination on cloudy as well as clear days.

The shop is open to the old car wheel shop by way of the transfer table for wheel and axle repairs and replacement. The equipment of the new shop consists of the jib cranes, two 15-ton Whiting traveling cranes, one 16-ft. air clamp, two Buffalo combination punching and shearing machines, one drill press, one double dry grinder and one straightening

stall. The 32-ft. transfer table which served the car shops under the old layout has been replaced by a Whiting 100-ton, 80-ft. transfer table.

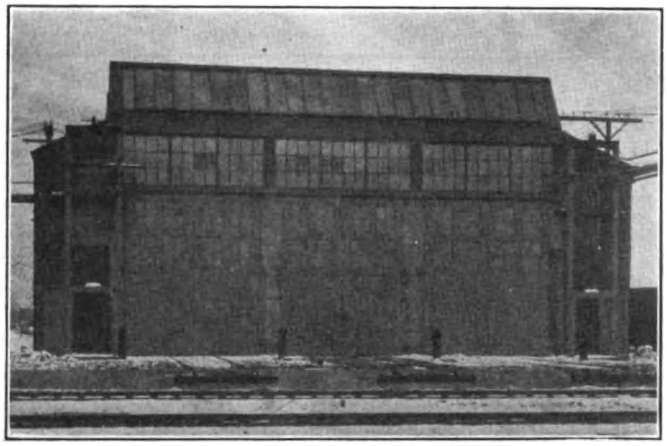
Wood Car Shop

The wood car shop, lying directly across the transfer table, is served by three tracks running from the table lengthwise through the building and out into the yard at the south end. This shop is of timber frame covered with Robertson



Flanging Clamp and One of the Buffalo Combination Punching and Shearing Machines

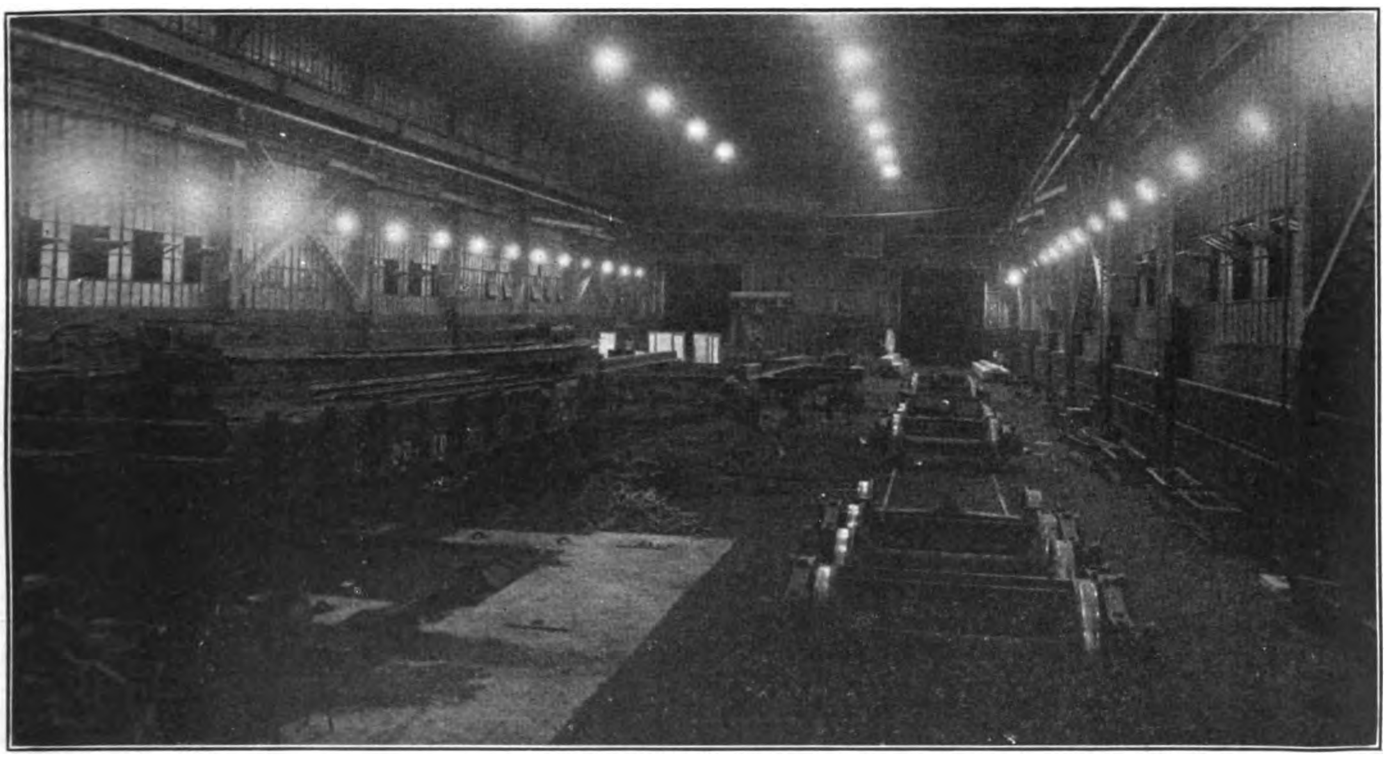
process metal, the building being 65 ft. wide by 240 ft. long. The center track is intended for truck repair work when all-wood cars are going through the shop, the car bodies paralleling the trucks, mounted on dollies on the outside tracks. outside tracks. These balconies are connected together by three equally spaced lift bridges over each side track, giving a continuous working floor at car roof level. In addition, scaffolds carried on brackets attached to the building posts and adjustable to any desired height, are located along both



Wood Car Shop—Outside Material Elevators Shown at Right and Left

sides of each of the car tracks. Four specially designed electric hoists are provided over the side tracks at each end of the shop to lift the car bodies from the trucks. These take the place of the usual jacks and by their comparatively rapid operation save considerable time in handling car bodies.

To facilitate the movement of material to the balcony without taking it through the main floor of the shop and causing congestion, two 3,000-lb. elevators have been constructed outside the wood shop building. These enable lum-



Night Work Is Facilitated by Ample Artificial Illumination—Foundation and I-Bolts for the Jacking Stall Shown in Left Foreground

A Box, 7½-ton, electric traveling crane, operated from the floor, spans the center track and assists in handling the trucks.

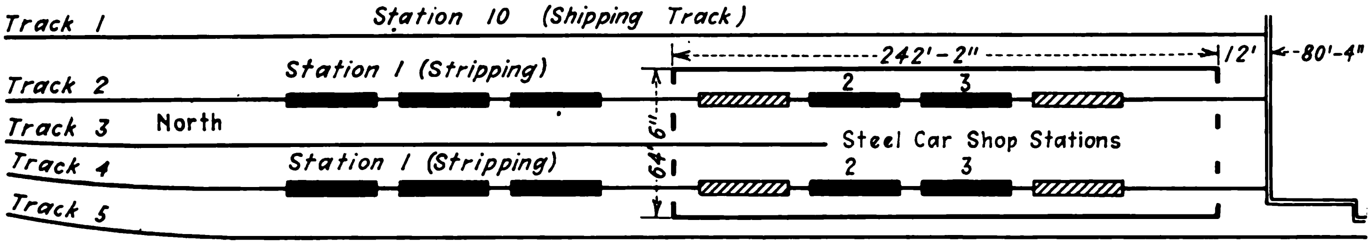
Balconies at car roof level extend through the shop in the center track bay and in two narrow bays outside of the two

ber and other materials to be elevated on the outside and taken directly into the shop on the balcony level. The building is connected with the mill room, carpenter shop, blacksmith shop and car wheel shop via the transfer table.

The building is well-lighted by saw-tooth skylight con-

struction and two tiers of Truscon side wall sash which extend the full length of each side. To take care of the increased size of the car department, service and locker facilities are provided in an extension the entire length of the west side of the old coach shop, the most central location shops from station to station, as shown in the layout drawing, thus eliminating back travel and reducing lost time.

Specialized gangs become familiar with the work at their respective stations and, in addition, all the tools needed for the most efficient carrying on of that particular work are



Layout of New D. & R. G. W. Car Shops at Denver, Col.—Stations Used in Repairing Composite Gondolas Are

that is available to the workmen in this department.

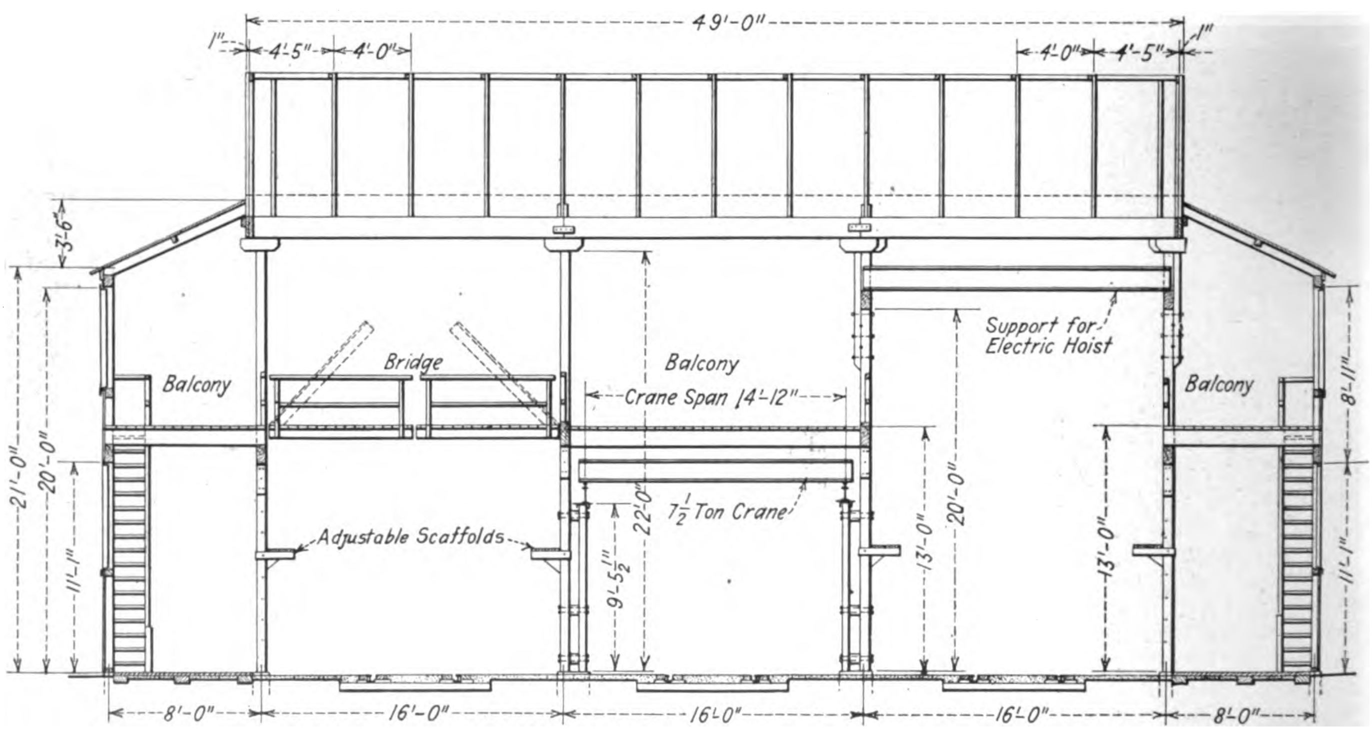
An effective exhaust steam heating system, made by the Bayley Manufacturing Company, Milwaukee, Wisc., has been installed and makes the shop a comfortable place in which to work in the winter. This feature, combined with good light and protection from the rain, is particularly appreciated by car repair men who were formerly compelled to work out of doors in all seasons of the year and under all weather conditions.

Both the steel and wood car shops are equipped throughout with air, electricity and oxygen and acetylene gas.

Work Carefully Organized

The main idea of the engineers in the design of the new D. & R. G. W. car shops was to provide equipment and a kept near at hand. Parallel track operation, provided also as shown in the layout drawing, facilitates the organization of competing gangs and moreover, when the car maintenance work must be curtailed, one side of the car shop can be shut down, maintaining the same maximum efficiency on the remaining track.

When all is in readiness to move the cars from one station to the next, six-foot cables are stretched between the couplers, and all the cars on one side are moved at the same time by an electric car haul. Evidently, therefore, each gang in the line must complete its work on time or hold up the entire movement. To provide for an unusual amount of work at any station and prevent shop delays from unexpected difficulties, floating gangs are available to help out at each point. The organization of the D. & R. G. W. car shop



Section Through Wood Car Shop Showing Balconies, Lift Bridges, Electric Car Hoist Supports and 7½-Ton Truck Crane Over Center Bay

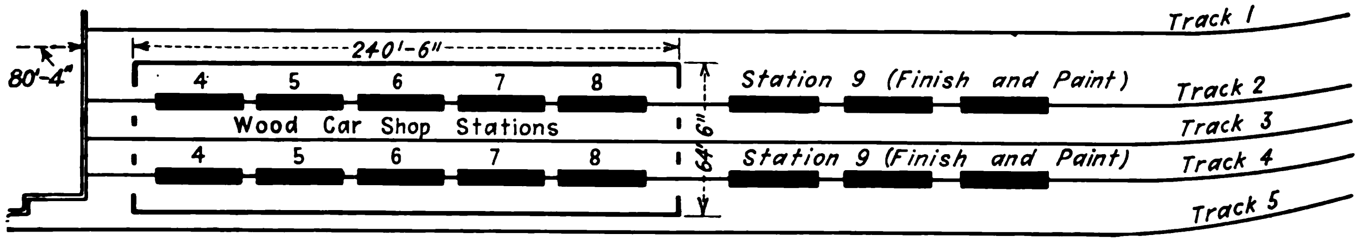
shop layout which would enable cars to be repaired in the least possible time consistent with good work and at the least cost. As large a number of men as can work together without interfering with each other are employed on each car all the time it is in the shop. Consequently, while the shops are relatively small, cars are put through rapidly and returned to service with the least possible delay. Both cars and material are given a straight line movement through the forces into friendly competing gangs adds greatly to the interest of the work and materially speeds it up.

Balconies Facilitate Work on Box Cars

One of the factors in the shop design enabling a large number of men to work on each car without interference is the balconies which are intended for a gang organized to manufacture and trim doors, handle roofing, running boards.

saddle work, etc., on box cars. The balconies are at practically the same level as the car roof so that the gang which handles the work mentioned does not have to climb up and down ladders or scaffolds in doing it. Moreover, the balconies afford a considerable storage space for roofing material, running boards, carriage bolts, small castings, door fixtures, nails, etc., all of which material can be trucked to the balconies by way of the outside elevators without going into the shop at all on the main floor. The doors for the box cars can be lowered into place from the balconies by means of the electric hoists at the south end of the shop.

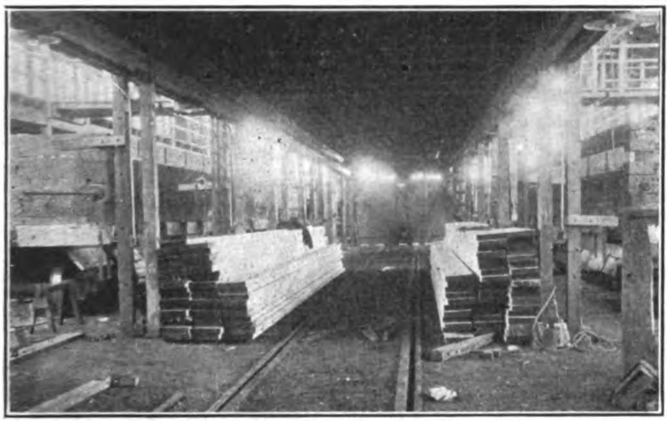
In planning for this method of car repairs, the designers contemplated careful scheduling of cars by classes and arranging for all repair materials based on careful inspection previous to shopping. Experience so far bears out the importance of making sure that all the material required for repairing a series of cars is ordered in advance and will be available at the shops when needed.



Indicated—Cross-Hatched Positions Are Used When Other Types of Steel Cars Are Going Through the Shop

New Shop Organization Gets Results

The advantages of the D. & R. G. W. car shop layout and organization described were apparent from the first. A total of 648 flat bottom gondolas of 40-ton capacity practically requiring rebuilding, were lined up for the Denver shops. Of these cars 319 cars (Series 26,000) were equipped with drop bottoms, the other 329 cars (Series 27,000) being of the plain, flat bottom type. These cars were rebuilt with Symington type steel center sills, Farlow key-type draft gear and A. R. A. standard type D couplers. Necessary repairs were made to the trucks, but, for the most part, new sills, side stakes, planking and dump rigging were applied throughout. Some reclaimed material was used.



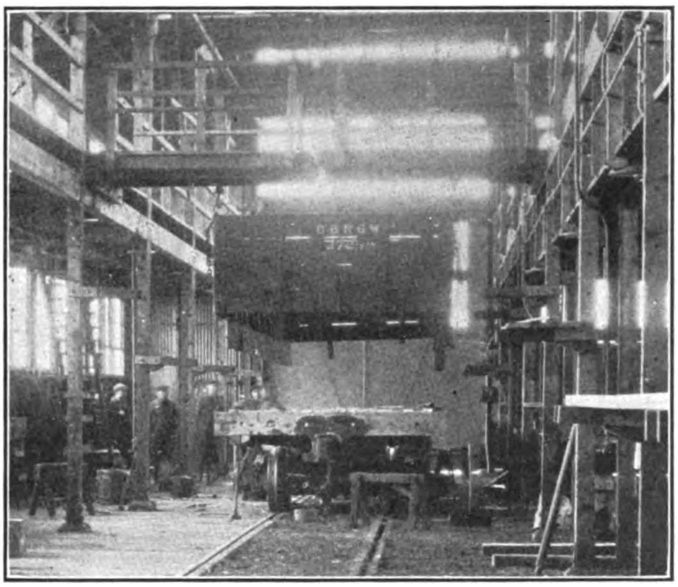
Center Bay of Wood Car Shop Served by 7½-Ton Box Crane for Handling Trucks when All-Wood Cars Are Going Through the Shop

With 56 first class car men in the wood shop, 14 steel car men and 23 men in the stripping gang, three of these cars a day were put through the shops in March when the shops were first opened. In about three weeks, when the forces were better organized, the output advanced to six cars a day. The shops were at that time working eight hours a day, six days a week. When the output increased to six cars a day the wood shop force was reduced to 44 men, the output dropping to four cars a day. This was the mark originally set for both Denver and Salt Lake. The shops made a slightly better showing with the 27,000 class than with the 26,000 class cars for the reason that the latter have a considerable amount of dump shaft mechanism not on the former.

Route of Freight Cars Through Shops

All cars are received at the north end of the shops. Steel cars through the steel shop only; composite cars pass through the steel shop, over the transfer table, and through the wood shop; and all-wood cars pass through the wood shop only. At present the shipping track is also at the north end of the shop but eventually the tracks south of the wood shop will be straightened out to hold 10 cars each for painting and shipping. It is also the intention to straighten out the tracks north of the steel shop to hold 12 cars each for stripping.

While normally the cars move from station to station through the shops there is sufficient flexibility, particularly in the steel car shop, to permit of handling cars requiring a variable amount of work. Where composite or steel cars requiring work of the same nature can be lined up in sequence, they pass through the steel shop in progressive order on one or both of the through tracks. Where the amount of work is unequal, one or both of these tracks may be used in handling cars for heavy repairs, and other cars coming in at the north end can be repaired and moved ahead by the use of the traveling cranes. These cars are unwheeled at the north end of the steel shop, the trucks being repaired and replaced under the bodies at the south end. In this way, all-steel and steel underframe cars may be repaired at

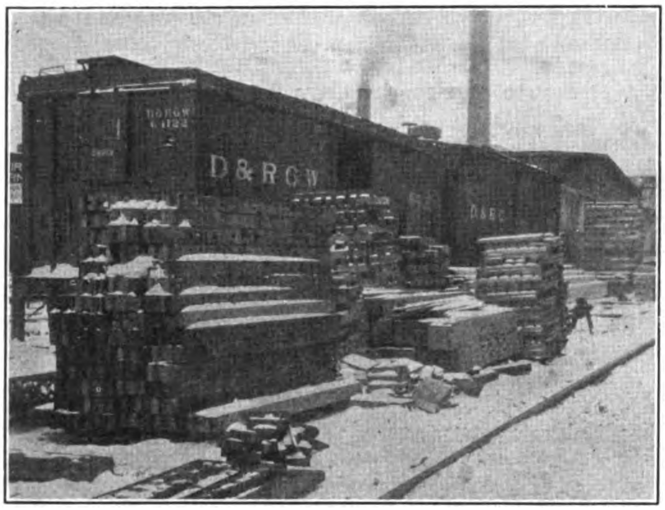


Gondola Sides and Ends Saved on This Car Being Reapplied to New Steel Underframe and Sills by Means of Electric Hoist

the same time. All-steel car bodies requiring straightening are moved into the shop at the north end, on the center track, on which is located the straightening frame already referred to.

Method of Repairing Flat Bottom Gondolas

The stations used in repairing the flat bottom gondolas referred to in this article are shown in the drawing. Station 1, north of the steel car shop, is used for stripping, this work being performed on tracks 2 and 4. Truck repairs are made just inside the steel car shop; the steel needle beams, body bolsters, draft gears and couplers are applied at Stations 2 and 3. Most of the steel shop machinery is located in the south end of the shop. The gondolas are advanced across the transfer table on their own trucks, passing consecutively through Stations 4 to 8 inclusive in the wood shop, during



Piles of Reclaimed Material Ready for Use

which time all wooden sills, side stakes, planking and drop doors are applied. Finishing operations are performed just south of the wood shop at Station 9 and one coat of paint is applied. The cars are then switched to the shipping track at Station 10, where a second coat of paint is applied, the cars stencilled and brakes tested. The detailed operations performed at each of the stations are shown in the following list:

Station 1 (north of steel car shop)—
- Strip and dismantle cars complete.
- Trucks placed on Tracks 2 and 4 just inside steel shop.

Station 2 (in steel car shop)—
- Apply body bolsters and steel needle beams.
- Fit up, drill and ream holes.
- Rivet body bolsters and steel needle beams.

Station 3 (in steel car shop)—
- Apply draft gears, keys and keepers.
- Apply couplers.

Station 4 (in wood car shop)—
- Apply all sills including steel.
- Apply two sub sills.
- Apply bolts to all sills.
- Apply body truss rods and cotters.
- Apply body truss rod saddles.
- Apply end and side sill knee braces
- Apply dump chain chaffing iron (32).
- Apply body cross rods.
- Apply end sill tie rods.
- Apply brake staff bottom support bolts.
- Apply striking blocks.
- Apply body truss rod turn buckle board and cotter keys.
- Apply wrought iron filler under body bolster and metal needle beams.
- Hang side straps on cross rods.
- Apply all bolts.
- Apply all grip nuts.
- Tighten all bolts.
- Tighten uncoupling and casting bolts (eight).
- Apply four sill steps.

Station 5 (in wood car shop)—
- Apply header block caps.
- Apply draft sills and inter sill fillers.
- Apply air brake cylinder and bolts.
- Apply air brake cylinder filler blocks (two).
- Apply dump doors, hinge pins and cotter keys.
- Apply decking and nail with Dayton nailing machine.
- Tighten four bolster cross rods.
- Apply side and end stakes.
- Apply one bolt in each side and two bolts in each end stake.
- Apply draft sill filler bolts.
- Apply brake cylinder block split bolts.
- Apply floating lever fulcrum and bolt.
- Apply twelve lag screws. Inter sill fillers.
- Apply pipe fitting for release valve.

Station 6 (in wood car shop)—
- Apply all side and end plank complete.
- Apply all inside and outside corner iron bands.
- Apply all side stake hip straps.
- Apply all side stake hip strap U-bolts.
- Bore all holes in end and side planks with pneumatic tool.
- Tighten side and end plank bolts with socket wrench.
- Apply side sill and bottom end plank corner irons.
- Apply six side grab irons.
- Apply two end grab irons.
- Apply safety lever pawl and space spools.
- Apply safety lever pawl plates with eight machine bolts with grip nuts.

Station 7 (in wood car shop)—
- Apply dump shaft filler blocks.
- Apply dump shafts.
- Apply dump shaft chain U-bolts with grip nuts.
- Apply dump shaft front housing plank.
- Apply dump shaft top housing plank.
- Apply dump shaft top housing plank straps.
- Apply four winding levers.
- Apply four safety levers.
- Apply eight dump shaft ratchet wheels.
- Apply dump shaft winding lever brackets.
- Apply four end grab irons.
- Apply eight side grab irons.
- Apply 32 dump door chains to dump shafts, 64 bolts.
- Apply safety lever fulcrum pin bolt riveted.

Station 8 (in wood car shop)—
- Apply cylinder and floating lever carriers.
- Apply two top brake rods.
- Apply two top brake rod carriers.
- Apply one cylinder connecting rod.
- Apply one hand brake rod and chain.
- Apply one cylinder push rod.
- Apply one cylinder lever.
- Apply one floating lever.
- Apply two uncoupling rods and Vilico uncoupling attachment.
- Apply four uncoupling rod brackets.
- Apply one brake staff.
- Apply one brake staff top bracket and brake pawl.
- Apply one brake staff top bracket filler block.
- Apply one brake staff ratchet wheel and key.
- Apply one brake staff wheel.
- Apply one brake staff step board with two split bolts and six lag screws.
- Rivet all safety appliance bolts.
- Apply four end sill grab irons.
- Apply one brake staff foot board grab iron.
- Apply all brake connecting pins and cotters.
- Apply two Acme pipe clamps.
- Apply one retaining valve with two ⅜ in. bolts.
- Apply two release rods, cotters and carriers.
- Apply one release valve pipe bracket.
- Apply two vertical grab irons.
- Apply two vertical grab iron J-bolts.
- Air brakes cleaned and oiled.
- Apply brake pipe.
- Apply brake pipe strainer.
- Apply two 8-in. brake pipe nipples.
- Apply two 1¼-in. self locking angle cocks.
- Apply retaining valve piping complete.
- Cut off ½-in. and ⅝-in. bolts with bolt clippers.

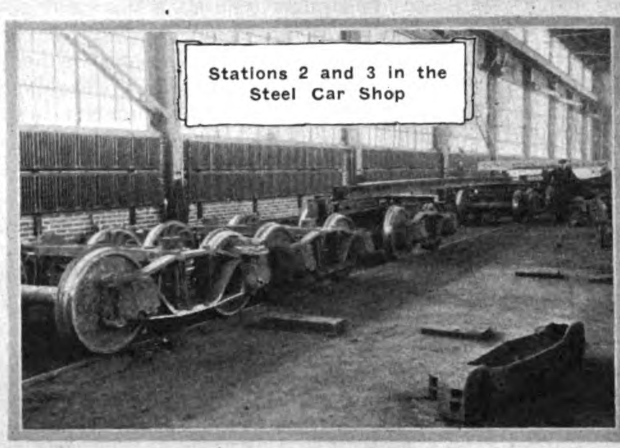
Station 9 (south of wood car shop)—
- Apply one brake staff bottom support.
- Apply brake staff cotter key.
- Apply two end sill brake pipe holders.
- Apply two carrier irons. Rivet onto steel center sills.
- Steel men ream holes in wood shop for car men.
- Where metal parts connect, paint with red lead.
- All wood work, where covered with metal, painted with mineral paint.
- All tenon and mortise joints paint with mineral paint.
- Car receives first coat of paint.
- Adjust air brakes.
- Test air brakes.
- Fit up pipe for air men in wood shop.
- Apply end sill brake pipe holder U-bolts with grip nuts.

Station 10 (shipping track)—
- Apply two bottom rods.
- Apply missing or worn out brake shoes and keys.
- Raise car to standard height.
- Tighten bolts when overlocked in wood shop
- Adjust air brakes.
- Test air brakes.
- Apply second coat of paint and stencil.

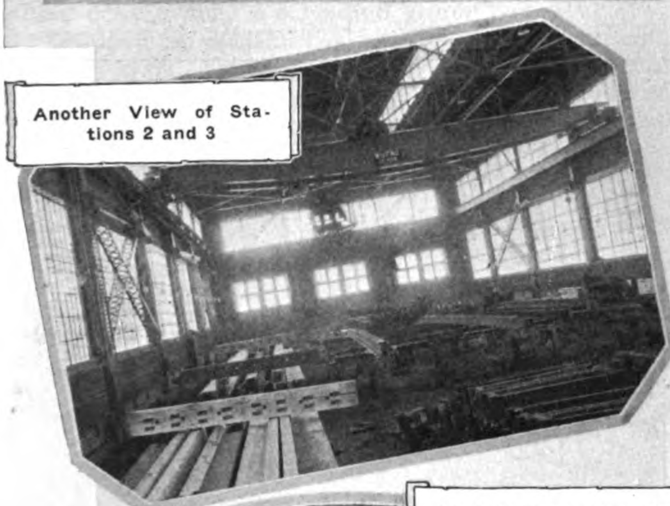
The forge shop and mill room work in conjunction with the car shop. All framing is done in the mill room, only the side and end planks being bored in the car shop proper. A Ford tractor and trailer system is used for delivering material to the men at the various stations.

Particular attention is paid to the reclamation of all scrap wood and metal parts capable of giving further service. The extent of this work will perhaps be indicated by the piles of reclaimed material shown in one of the illustrations. A special gang is used, with four laborers for stripping and handling wood and iron. Three laborers are employed picking up and sorting, nuts and washers; one man straightens second-hand bolts and another handles these bolts to the threading machine, later delivering them to the shop.

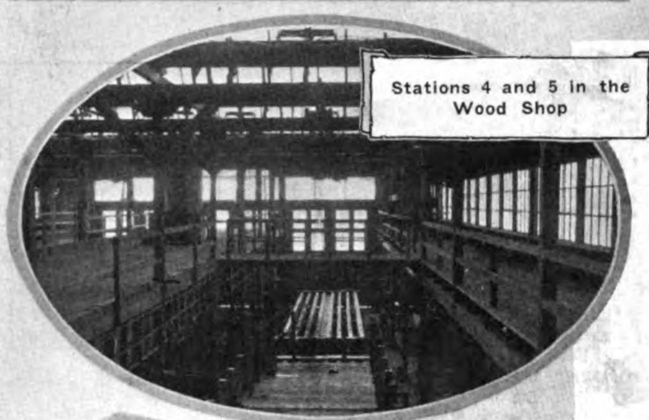
Stripping Station North of Steel Car Shop



Stations 2 and 3 in the Steel Car Shop

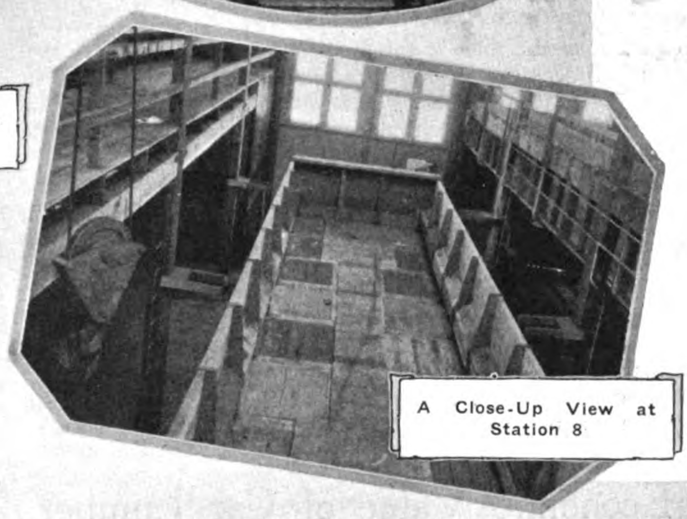


Another View of Stations 2 and 3



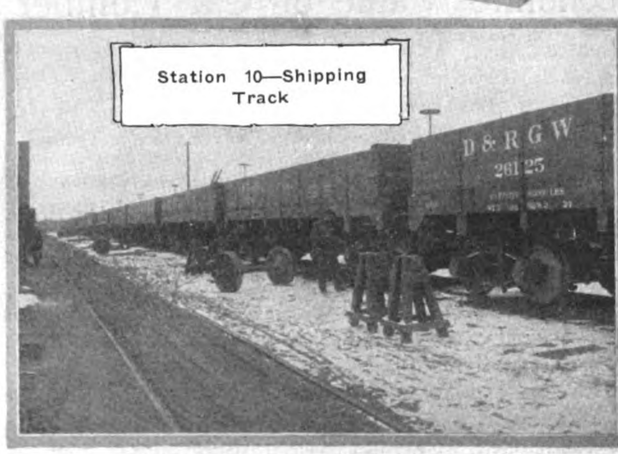
Stations 4 and 5 in the Wood Shop

Stations 7 and 8 in the Wood Car Shop



A Close-Up View at Station 8

Station 9 South of Wood Car Shop



Station 10—Shipping Track

A Story in Pictures of the Work Carried on at the Various Stations During the Repair of D. & R. G. W. Flat Bottom Gondolas

High Standard of Morale Maintained

The article would be incomplete without a comment regarding the high standard of morale evident among the car shop supervisors and men at the new shops. Almost without exception these are experienced car men who know what their work was like under former conditions and appreciate and are proud of the fact that they now work in modern, comfortable shops provided with the latest labor-saving equipment and devices. Perhaps the morale of the men is best shown by their willingness to adapt themselves to the new conditions and produce a good output. It is also shown by their interest in the prevention of accidents. Men in the car shop are doing their level best to get a better record in this

Safety First Board Showing the Record of Accidents in Various Shop Departments

respect than the men in the locomotive department. A record of all accidents is posted on the bulletin board shown in one of the illustrations. This record shows that in the month of March, for example, there were only two reportable accidents in the car department.

The information and photographs presented in this article were secured by the courtesy and assistance of W. J. O'Neill, general mechanical superintendent of the Denver & Rio Grande Western, P. C. Withrow, mechanical engineer, B. F. Fry, general supervisor of car construction and repairs, and Battey & Kipp, consulting engineers, Chicago, who designed and constructed the new car shops, as a part of the rehabilitation program which also included the new D. & R. G. W. locomotive shops and engine terminals described in a previous issue.

Economic Value of Car Lumber Preservation

By F. S. Shinn

Supervisor, Treating Plant, Chicago, Burlington & Quincy

TODAY, when the railroads are being pressed more closely than ever before to show a return on their investment, it is imperative that every bit of material used shall be of such character that it will give the most economy. In connection with this many of the roads are going more and more to the use of steel cars, or at least putting steel sills in their wooden cars. There is no question but that timber is the best type of material for building cars due to the fact that it is cheap, adaptable and easily handled, but because of the fact that it rots quickly car builders have to a certain extent condemned wood and started using steel. The use of untreated timber for car material should be abandoned, but if we will use treated timber we will effect a larger saving than has yet been developed by any feature of car building.

Compiling data from many shop superintendents and car repair foremen, I submit the following facts: The average life of untreated car timber is as follows:

Stock car decking	2 to 5 years
Stock car sills	5 to 8 years
Stock car roofing	4 to 6 years
Flat car decking	6 to 8 years
Flat car sills	8 to 10 years
Box car sills	6 to 10 years
Refrigerator sills	4 to 5 years

Carefully kept records for a period of one year in one of the biggest car shops in the country has brought out the fact that 82 per cent of all timber removed from cars was removed on account of decay.

I have heard it said quite often that box car sills will not decay. The illustration (Fig. 1) does not bear out that statement. I have seen dozens of box car sills as badly decayed as the one shown. Stock car sills, stock car decking and refrigerator sills decay after only a few years' service.

In 1911 the Chicago, Burlington & Quincy began treating stock car decking and sills, and in that year built 200 new stock cars, using treated sills and decking. These cars are still in service with the original treated material, and in practically as good condition as when built. The average life of the untreated material is four years for decking and six years for sills, while the C. B. & Q. by treating it with the full-cell process with 12 lb. of creosote per cu. ft., has obtained 13 years' service and the treated material is still in

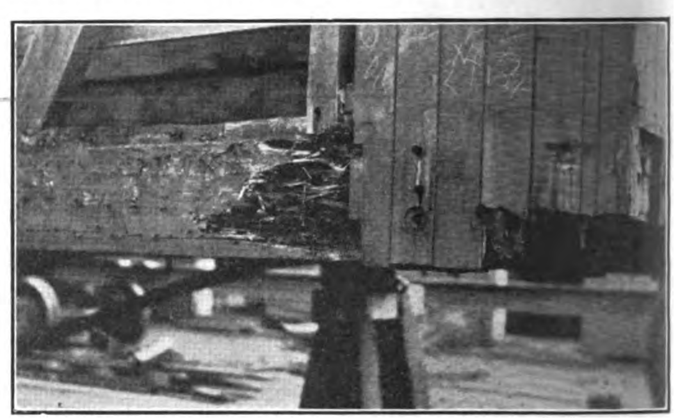


Fig. 1—Box Car of Untreated Lumber Built in 1916—Decayed Condition after Seven Years' Service

good condition, so that it is safe to estimate that it will give an additional life at least again as long as untreated material.

The economy of treating car material is brought out by the following example:

COST OF STOCK CAR DECKING

648 bd. ft. (36-ft. car) at $47 per 1,000 bd. ft.	$30.45
Labor of laying deck on car	7.50
	$37.95
Treatment	21.64
Total	$59.59

The above cost of treatment is arrived at as follows:

12 lb. creosote per cu. ft. at 25 cents per gallon	$18.40
Charges for operating treating plant at 6 cents per cu. ft.	3.24
	$21.64
Untreated decking ($37.95) gives four years' life, or an annual maintenance of	$9.49
Treated decking ($59.59) gives 17 years' life, or an annual maintenance of	3.50
Saving per car on decking alone	$5.99

The above prices of material probably will not apply in all cases; that is, conditions may be such that these figures will be too high in some localities and too low in others. However, these figures may be used as a basis from which to work, showing that there will be a saving effected by the

treatment of car material, and anyone wishing to determine this saving should use the prices that apply in his particular case.

In the stock car (Fig. 2) note the decayed end sill; it is of untreated white oak. Note the side sill and decking; they are treated fir. The car was sent to the repair yard because the end sill became decayed after seven years' service.

Many people are reluctant to invest as much as $21 in the treatment of a stock car decking or any other material unless they know that they are going to get this money back in extra years service, and that of course should be the thought in every man's mind who is using treated material. The above facts, however, should be convincing as to the economy of treating material. There are several different processes of treatment not nearly so costly as the treatment used by the Burlington which will give very good results and which will at least double the life of the material—Empty-cell

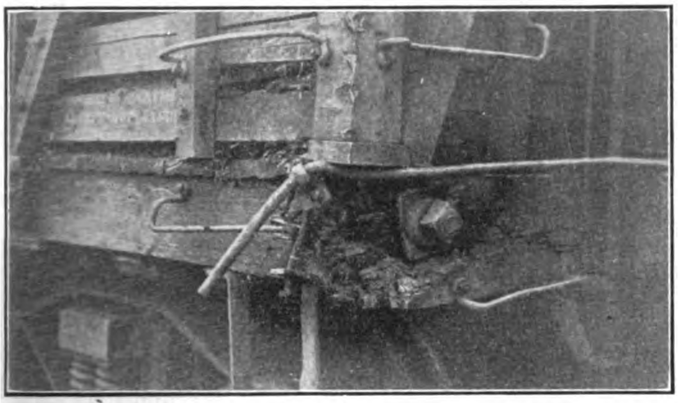


Fig. 2—Stock Car Built October, 1916—Condition in July, 1923. Decayed End Sill is Untreated White Oak. Sound Side Sill and Decking Are of Treated Fir

(creosote), Card (creosote and zinc chloride), and Burnettizing (zinc chloride)—as well as with the more expensive full-cell creosote process.

Treatment by any of the above processes will resist decay, if not definitely prevent it, and if we will check this decay we are going to get very much longer life out of our car material. One of the big troubles that is being used as an argument against the treatment of car material as I see it is the fact that many of the railroad shopmen from the superintendent down either fail to see or will not admit why car material really fails. Most of them say that it fails mechanically, when the real reason is that decay has weakened it beyond the safety point, and it cannot stand up. The early stages of decay are practically impossible for the layman to detect, but while still in its early stage rot will weaken wood to such an extent that it will reduce its strength as much as 50 per cent. A good preservative treatment will prevent this incipient decay.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Repairs to Safety Appliances

The Missouri Pacific rendered a bill against the Lehigh Valley on October 2, 1922, for the value of one brake staff complete with brake wheel and ratchet wheel on account of this equipment being missing from Lehigh Valley flat car No. 9817. The owners contended that a brake staff could not become missing in fair usage and that the staff had probably been taken off and lost while the car was being loaded or unloaded. It claimed that Rule 32 provided for the removal or cutting out of material from cars to facilitate loading as a handling line's defect and this rule also applied to brake staffs. The Missouri Pacific contended that it had no knowledge of the brake staff being removed to facilitate loading or unloading and it did not think it should be held accountable under Rule 32, as that a missing brake staff is listed as an owner's defect under Rule 33.

The following decision was rendered by the Arbitration Committee: "Under Rule 33 owners are responsible for expense of repairs to safety appliances where not involved with other delivering line damage. Therefore, the bill of the Missouri Pacific is correct.—*Case No.* 1298, *Lehigh Valley vs. Southern Pacific.*

Rule 120—A Change of Prices Before Repairs Are Completed

Under date of July 3, 1920, the Southern transmitted to the Southern Pacific a joint inspection certificate covering the condition of Southern Pacific car No. 79848 and asked the disposition of it under Rule 120. The estimated cost of repairs as shown on the joint inspection certificate amounted to $243.02. The Southern was authorized under date of July 12, 1920, to repair the car and render a bill for it. The handling line presented to the car owner a bill amounting to $432.45 for repairs made on authority of a repair card issued at Alexandria, Va., September 25, 1920. Allowing the $50 excess cost over the estimate as specified in Section (d), Rule 120, there was an overcharge of $139.43. The car owner requested counter-billing authority for the overcharge, but this was declined by the handling line on the grounds that the overcharge was due to increased prices for labor and material as specified in Supplement No. 3 to the 1919 Code of Rules, under which the repairs were priced, while the estimate submitted to car owner under date of July 3, 1920, was based on rules in effect on that date. The car owner claimed that if it had known that the total cost of repairing the car was to be so high it would have authorized dismantling it. The handling line contended that the car owner, having knowledge of the increase in prices for labor and material should have determined at once whether or not there would be an increase in cost of repairs and requested additional information, if necessary. The repairing line claimed that, owing to the large number of cars on hand for the car owner at the time, it was unable to make repairs promptly. As a result the repairs were not completed until September 27, 1920, or subsequent to September 1, 1920, at which time A. R. A. prices for labor and material were increased, which resulted in the increase for the total amount of repairs. No additional items were added to the repairs shown on the inspection certificate.

It was decided by the Arbitration Committee that the charge of the Southern Railway, based on prices in effect at the time repairs were completed, should be accepted insofar as the increased prices are concerned.—*Case No.* 1299, *Southern Pacific vs. Southern.*

Acceptance of Bad Order Cars by the Owner

In the early winter of 1920 numerous Maine Central and Bangor & Aroostook freight cars were moved over the Boston & Maine lines to Portland, Me., for delivery to the owners, bearing cards attached by other roads showing that they were sent home for repairs. The Maine Central was also delivering to the Boston & Maine at Portland, various foreign cars

to which similar cards had been attached by the Maine Central, in order that they might be moved to the home roads for reconstruction or demolition. The Boston & Maine later on refused to accept from the Maine Central foreign cars for movement to the home road for repairs, it being understood that this order was issued on account of the refusal of the Delaware & Hudson to accept such cars from the Boston & Maine for movement over its line towards the home road. On account of this order, the Maine Central on December 31, 1920, notified the Boston & Maine that it no longer desired to have its own cars accepted and moved to the home road for repairs unless the Boston & Maine was in a position to accept foreign owned cars from the Maine Central for movement to their home lines. Notice was at the same time given to the Boston & Maine by the Maine Central to the same effect with respect to the cars owned by the Bangor & Aroostook, which road had notified the Maine Central that it was not willing to have its cars moved home without authority issued by itself.

The Maine Central contended that Interchange Rule No. 2 provides that owners must receive their own cars when offered home for repairs at any point on their line, subject to the provisions of the rules. Rule 120, however, provides a method by which the owner may determine disposition of a car which requires general repairs, due to the owner's defects. The evident purpose of this rule is to provide for necessary repairs without home movement and to give the owner an opportunity to decide whether or not the cars are worth the expense necessary to return them to service in good condition. There is nothing in the Rules of Interchange which prevents any railroad handling defective cars at its own expense toward the owning road, neither is there anything in the rules which requires any road to move foreign cars home for repairs at its own expense. The Maine Central maintained that it was entirely within its right under the Rules in notifying the Boston & Maine to discontinue acceptance of its cars in bad order for delivery home as long as the Boston & Maine was not in a position, or was unwilling, to accept cars belonging to other roads which were in the possession of the Maine Central, and which must either be sent to the owner or handled under Rule 120 by the Maine Central.

The Boston & Maine maintained that Rule 120 was devised to give the holding railroad an opportunity to obtain authority from the owner of a car which, in its opinion, required repairs extensive enough to warrant its destruction, to destroy the car rather than to go to the expense of handling the car to the owner for such destruction. If the holding road desires to assume the responsibility and the expense of moving cars in general bad order to the owner, the owner has no right to refuse his own property provided it complies with the I. C. C. Safety Rules.

The matter was referred to the Arbitration Committee which rendered the opinion that the Maine Central was not within its rights in notifying the Boston & Maine not to accept from its connections Maine Central and Bangor & Aroostook bad order cars home bound.—*Case No.* 1,300, ***Boston & Maine vs. Maine Central.***

Responsibility for Damaged Car

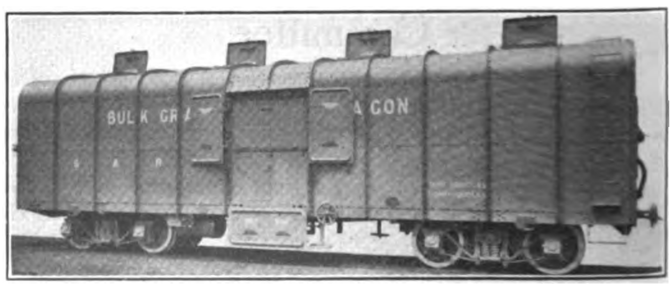
On November 2, 1922, while Seaboard Air Line car No. 16631 was being hauled in a Detroit, Toledo & Ironton train, upon its arrival at Springfield, Ohio, it was found to have six sills broken and various other defects, making it necessary for a statement to be furnished according to the footnote under Rule 43, as the handling line reported the car under Rule 120. The handling line was unable to advise the exact circumstances under which the car failed and, therefore, the car owner held it responsible for the damage to the car. The handling line reported that upon inspection it was found that the defects were the result of the decayed and weakened condition of the car and that personal investigation proved that the car had in no way received rough handling while in the train. However, the handling line admitted that it was unable to state just where the car failed. Again, on November 29, the owner received a request for disposition of the car in accordance with Rule 112, to which was attached the inspection certificate enumerating the defects. The handling line was advised that Rules 112, 120 and the footnote to Rule 43 had not been complied with. A representative of the owing road inspected the car at Springfield, Ohio, on March 17, 1923, and developed the fact that the breaks in the longitudinal sills were new defects apparently caused by rough handling. He also found that the car in question was overloaded according to Rule 86. The light weight of the car was 37,500 lb. and the net load 64,370 lb., giving a total of 101,870 lb., whereas the weight allowed by Rule 86 was 95,000 lb. gross. The car was therefore overloaded 6,870 lb.

The Arbitration Committee rendered a decision to the effect that the handling line is responsible on account of the failure to furnish a statement showing the circumstances under which the car was damaged, as per footnote to Rule 43. Arbitration Cases 1219 and 1283 are parallel.—*Case* 1302, *Detroit, Toledo & Ironton vs. Seaboard Air Line.*

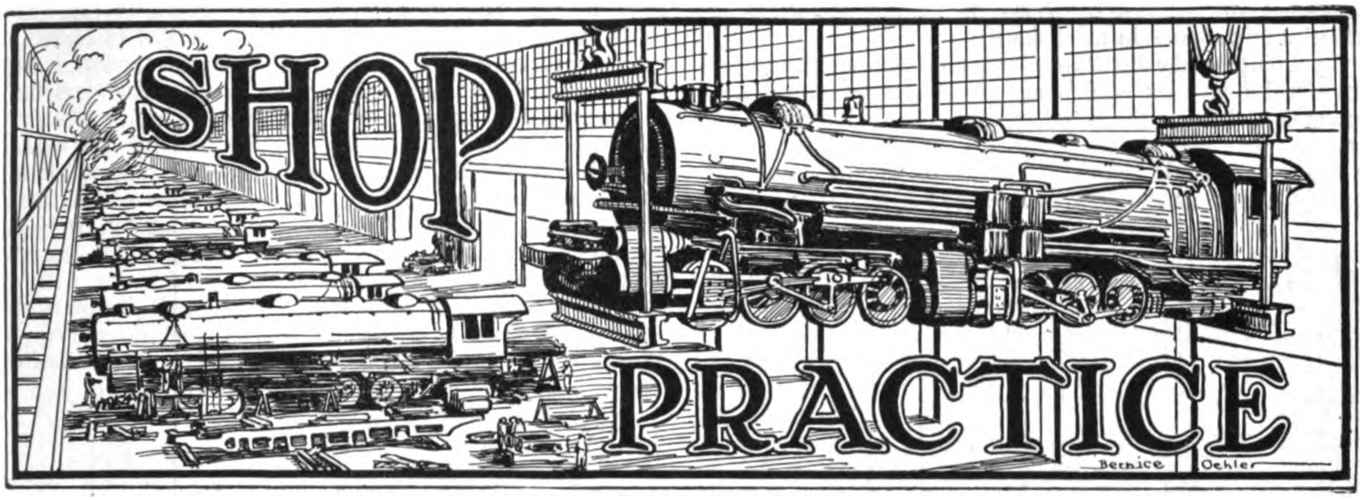
Responsibility for Damaged Car

On October 27, 1922, Seaboard Air Line flat car No. 43573 broke in two while in switching service on the Southern. On November 10, 1922, an inspection certificate showing in detail the condition of the car, was sent to the owner with a request for disposition in accordance with Rule 120. The owner declined responsibility on the grounds of unfair usage in service. The Southern notified the owner that the damage to the car was not the result of unfair usage. Car No. 43573 was a 60,000-lb. capacity, 40-ft. wooden flat car, weighing 27,000 lb., built originally in September, 1906. It was rebuilt in March, 1918, and equipped with short wooden draft arms and Farlow draft gear. The handling line contended that the failure of the car was the direct result of its light capacity, length and generally worn out condition. The car owner stated that it should have received a request for disposition of the car on October 27 instead of November 10, and that the handling line should have furnished a statement as to when, where, and how the car was damaged, in accordance with the note to Rule 43, so that the owner could advise the disposition of the car. The owner claimed that nobody on the handling line could explain how the car was damaged.

The matter was referred to the Arbitration Committee, which rendered the following decision: The handling line is responsible on account of the failure to show the circumstances under which the damage occurred, as per footnote to Rule 43. Arbitration cases 1219 and 1283 are parallel.—*Case No.* 1301, *Southern vs. Seaboard Air Line.*



Bulk Grain Wagon for End or Bottom Discharge Built for the South African Railways by The Leeds Force Co., Ltd., Leeds, England



Handling Driving Box Work*

The Proper Layout of Machine Tools and the Use of Special Fixtures Speeds Up Production

By J. H. Hahn
Machine Shop Foreman, Norfolk and Western, Portsmouth, Ohio

THE one most important feature in the handling of driving box work is the grouping of the machine tools and other equipment such as the bronze furnace, lye vats, etc., in a way that the handling of the boxes from one operation to another will be reduced to a minimum, thereby saving considerable time and labor in the process of overhauling after they have been removed from the locomotives, as well as in the manufacture of new driving boxes. Fig. 1 shows the grouping of machines for handling this work in the shop at which the writer is employed. The distance that

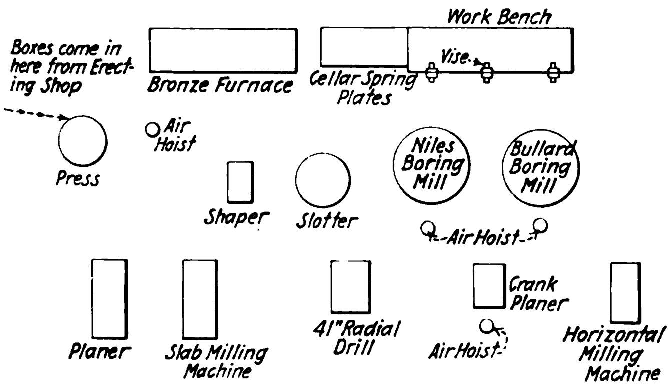
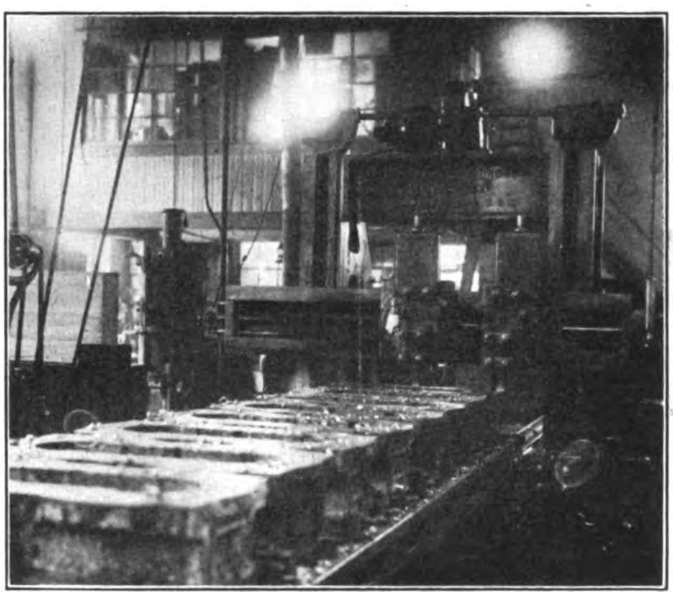


Fig. 1—Layout of Machine Tools in the Driving Box Gang

a driving box has to be trucked from the time that it is removed from the locomotive until it is ready to be replaced again has been reduced from about 2,000 ft. to less than 250 ft. In other shops that have recognized the value of grouping machines in this manner the distance has been cut from 5,600 ft. to about 300 ft. In making a check of our driving box work the first thing we did was to measure the distance that a driving box was traveling in our shop from the time it was removed from the locomotive until it was repaired and ready to be replaced on the journal. When we found that this distance was excessive we corrected the condition by rearranging and grouping the machines in the driving box gang. There is much room for improvement in this respect in a good many shops that the writer has worked in or



Boxes Are Set Up on Planer in Lots of 24 or More at One Time

visited, and we are glad to note that many of the shops are realizing the importance of grouping their machines and handling the work in such a manner that time and labor will be saved in the various operations involved. Fig. 1 also shows the various machines that are used in doing this work, and while the minor operations on driving boxes may differ

* Awarded the prize in the driving box production job competition which was announced in the February *Railway Mechanical Engineer*.

somewhat in the various shops the major operations are practically the same in most shops.

By grouping the machines and other equipment the time for scheduling a set of driving boxes for a certain class of locomotive through the shops may also be decreased considerably. The driving box work is handled on this road by a regular schedule which is posted in the machine shop weekly and is taken from a master schedule board which does not differ much from those in use on other roads using a scheduling system.

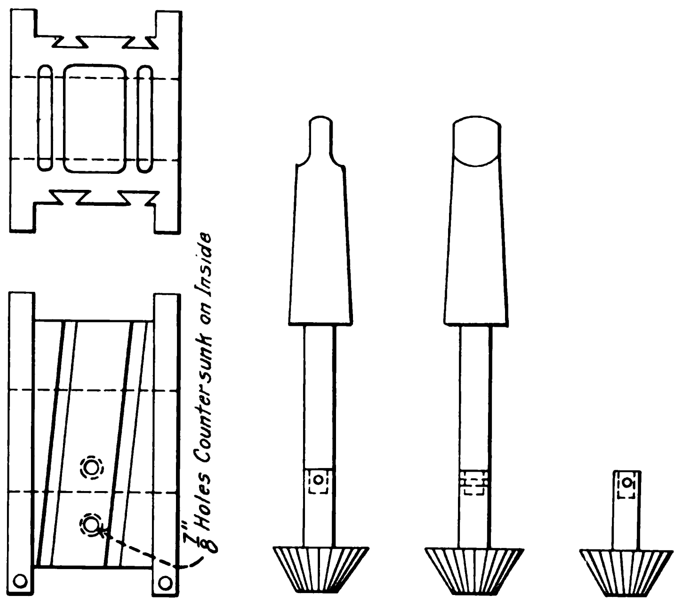


Fig. 2—Showing Method of Dovetailing Boxes and the Special Tool for Countersinking Anchor Pin Holes

Thorough Inspection Essential

After the boxes are removed from the wheels they are conveyed to the lye vat on electric trucks, where they are thoroughly cleaned and then transferred to the machine shop by truck. After reaching the machine shop a machinist and one helper inspect all boxes closely for cracks, loose crown brasses, worn crown brasses and other defects. All boxes are properly stenciled and recessed for collars on the crown brasses. If the brasses are to be renewed they are pressed out of and into the driving boxes on a press designed and constructed on this road for such work which is used as standard on account of the limited floor space it requires.

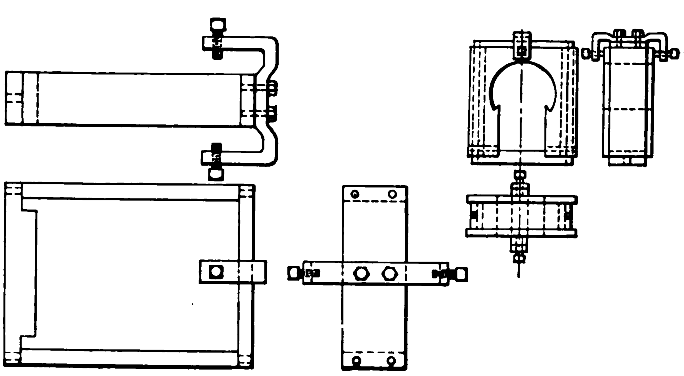


Fig. 3—Special Form Used for Bronzing Driving Boxes

All crown brasses that are thick enough and tight in the boxes are rebored and put back into service. All boxes are calipered for being parallel on the shoe and wedge faces and those that are tapered or require planing for other reasons are trued up on a Newton 32-in. crank planer. The limit for wear on the shoe and wedge faces of the boxes is set at 3/4 in. or 3/8 in. on a side for the reason that we cannot bronze a box and get good results on anything less than 3/8 in. and all boxes are rebronzed and planed to standard after reaching this wear limit. No driving boxes are welded up and all cast iron boxes are scrapped and cast steel boxes used to replace them. The limits for thickness of the crown brasses, if tight in the boxes and in good condition, is 3/8 in. for boxes for heavy Mallet locomotives and 1/4 in. for the Consolidation and smaller locomotives.

When a box has been reduced by wear to 3/8 in. below the original or standard size it is grooved and dovetailed, as shown in Fig. 2, and anchor holes drilled. This method of grooving driving boxes is used because it can be done at one set-up and prevents the bronze from working out if it should get loose, as the general tendency is for the bronze liner to work up, and this upward movement tightens the bronze in the grooves. The special countersinking tool shown in this illustration is used to countersink the holes from the inside which anchors the bronze firmly. The holes are drilled from the outside with a jig to insure getting them in line, the countersinking tool is inserted and the shank entered as shown and the operation of countersinking the holes from the inside is quickly done.

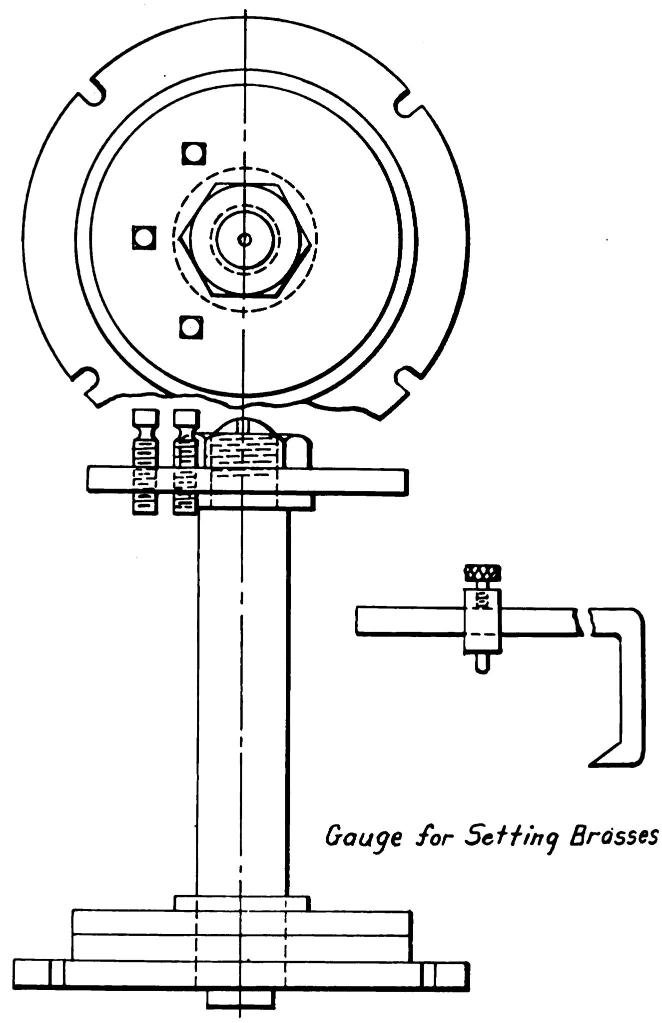


Fig. 4—Mandrel Used on Boring Mill For Turning Crown Brasses and Gage for Setting Brasses

Bronzing Repaired Boxes

Fig. 3 shows a special form we use for bronzing the driving boxes. This is done in order to get the boxes as near the finished sizes as is possible and get them smooth and

uniform. We find that from 10 to 30 min. per box can be saved in the total time for machining, and much better results can be obtained both in the bronzing room and in the machine shop. The form can be put on a box and removed in a few seconds; in fact, when working piece work the men prefer this form to the old method of pouring the bronze on the boxes. The form is held in position by tapered pins and the two set screws shown at the top are tightened up slightly. The forms can be easily and quickly made for all sizes of boxes and are inexpensive.

After the driving boxes have been inspected, those that are undersize are grooved and then bronzed with the special bronzing fixture shown in Fig. 3. The crown brasses are then turned on a Niles 36-in. boring mill on the special mandrel shown in Fig. 4. This mandrel has several good features. It will take the various sizes of crown brasses by merely changing the plates which are keyed to the spindle, and it is equipped with a set-up gage that enables the machine operator to set the brass before the machine is started. With this fixture an ordinary crown brass can be turned and chamfered in from 10 to 14 min., including setting up and turning the collars.

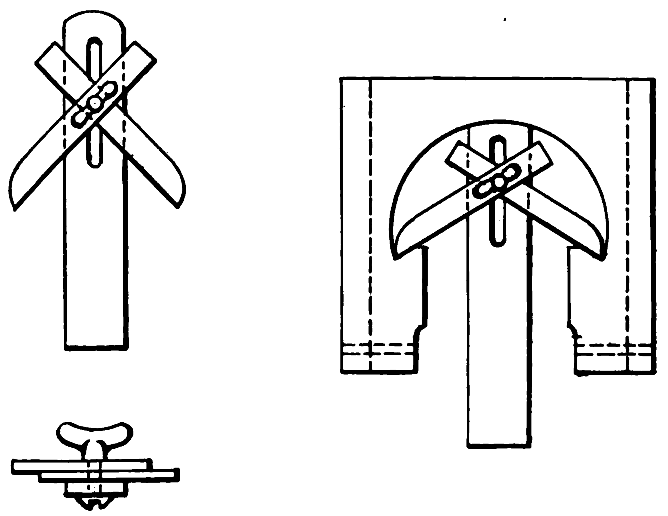


Fig. 5—Crown Brasses Are Laid Off with This Gage

After the brasses are turned they are laid off with the gage shown in Fig. 5, and then they are slotted on a 24-in. Dill slotter in a special fixture. There is no time lost in setting up these brasses as this fixture clamps the brasses square with the backs and they are slotted with a special tool that makes the radius on the brass at the same time that it is slotted for a fit in the boxes.

The methods of handling driving box work will differ somewhat, as opinion differs. The practice on some roads is to fit the crown brasses in such a manner that the grain will run across the grain in the driving boxes. This method is used on this road as there is a general opinion that this method produces better results in that the brasses when applied in this way remain tight in the box and the percentage of loose crown brasses is very low. All crown brasses are applied with collars, and no pins are used.

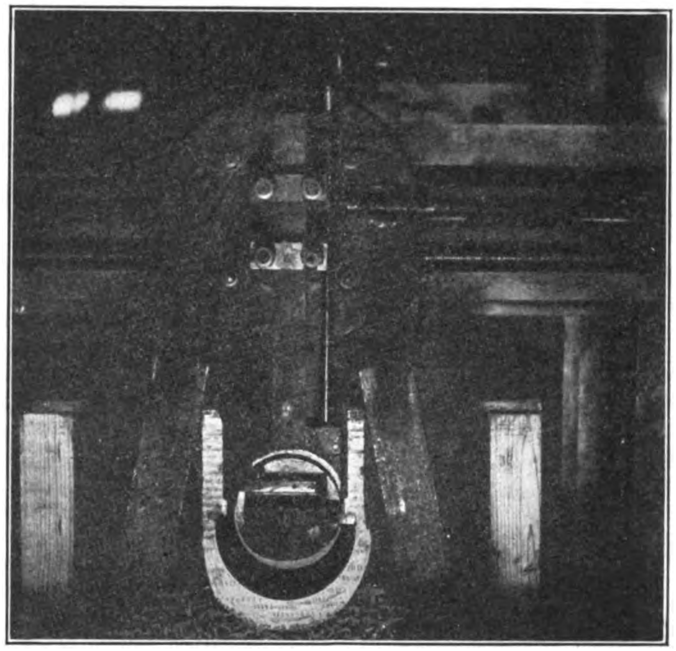
Some of the boxes have the bronze liners cast on the hub faces. These are applied by grooving and dove-tailing the boxes and pouring the bronze on them, after which they are faced for lateral on a Bullard driving box boring machine. Several anchor holes are also drilled in the faces of the boxes before they are bronzed. All driving boxes are faced while being bored at the one operation and are carefully checked after they are bored with the gage shown in Fig. 6. The limit on this check is 1/64 in. out of center. All boxes for heavy Mallets are bored 1/32 in. larger than the journals, the others are bored 1/64 in. full larger than the journals. All boxes are relieved on the edges of the crown brass bore with a special tool while on the Bullard box mill, and the boxes are ready to apply to the journals as soon as oil grooves are chipped, no filing or fitting being done on the boxes in the erecting shop.

Organization of the Work

The different machines used for driving box work are shown in Fig. 1. All of the work on the driving boxes is done within the space shown, which reduces to a minimum the handling of the boxes for the various operations. The horizontal mill is used for milling the spring seats, for milling the grease cavities in the crown brasses and for boring the radius in the driving box cellars for the journals. The other machines are the usual machines found in most shops for handling this class of work.

All boxes are fitted complete in the driving box gang. Cellars, cellar bolts, spring plates and perforated plates are applied before the boxes are sent to the erecting shop. Boxes are delivered to a designated location in the erecting shop by the transportation trucks. Hooks are used for lifting the boxes with the cranes and placing them on the journals. These hooks fit into the oil holes on the shoe and wedge faces of the boxes and facilitate safe handling. We find that a good set of driving box hooks for each machine saves considerable time and prevents a good many accidents.

All crown brasses, boxes, cellars, etc., are properly stencilled and fitted up in the machine shop. One machinist and a helper will take care of from 6 to 12 engines per week by a systematic layout and good facilities for handling the work. In shops where piecework rates obtain for this work it is essential that special tools, jigs, fixtures, etc., be employed, and much attention should be given the matter of grouping machines, and bringing the work together in such a way that all lost motion may be entirely eliminated. This matter requires close study and constant attention.



Special Tool for Planing Radius for the Crown Brass Fit

The boxes can be finished on the shoe and wedge faces after crown brasses have been applied by placing a set on each side of the planer table clamped to a special fixture. The Ingersoll planer type slab miller can be employed to good advantage in machining the boxes on the shoe and wedge faces after they have been bronzed. This work is handled mostly by one operator and a helper; the helper removes and replaces the boxes as soon as they are com-

pleted. The usual design of fixture furnished by the makers of the machines is employed for holding the driving boxes.

The grease cavities in some cases are cast in the crown brasses and in others they are milled, using the horizontal boring mill and a 1½-in. right hand end mill for this operation. We find that milling the grease cavities gives a brass absolutely free from core sand and tends to prevent hot box trouble.

Blank forms are filled out by the inspectors when checking driving boxes and the journal sizes are furnished to the men on the boring mill and also to the man who fits up the cellars. These forms are filled out after the wheels pass through the wheel gang and journal lathes. The forms are then filed away with the other reports for future reference and check

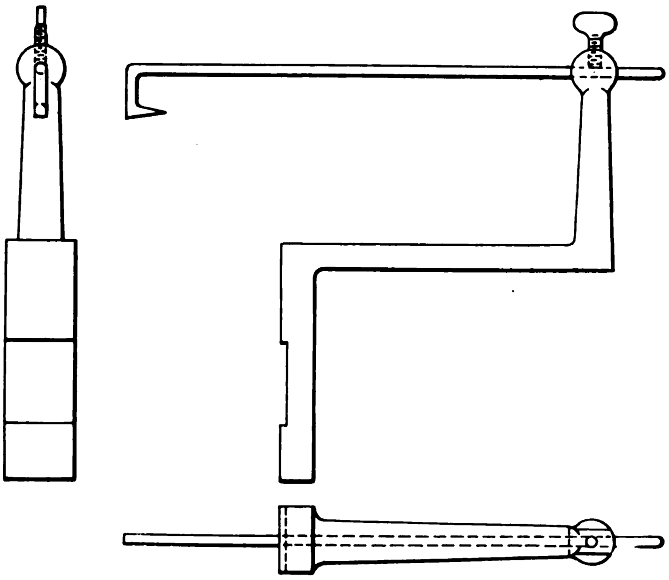


Fig. 6—Gage for Checking Crown Brass Bore

on the work that was done on the driving boxes while the engine was in the shop.

The layout of machines shown is sufficient to take care of from 15 to 25 engines per week working two shifts on some of the machines when necessary. This work, of course, includes simple engines for which 6 to 8 driving boxes constitute a set, and some of the heavy Mallet locomotives which have 16 boxes to the set.

Work on New Cast Steel Driving Boxes

All driving boxes being applied now on this road are of cast steel and the boxes are delivered from the foundry in carload lots to the machine shops. They are planed and faced to proper dimensions and are handled in lots of from 24 to 48, depending upon the size. After the boxes are faced they are set up on the planer bed in lots of from 12 to 16 or more, and the radius for the crown brasses is machined with the special tool shown in one of the illustrations which was designed at the Portsmouth shops. The idea of this bar is by no means a new one. However, the bar itself is entirely new in design as no bevel gears are used in the feed shafts, all parts of the bar proper being operated by a worm and worm wheel. The bar has a heel brace of very heavy construction to withstand the strain due to the long over-hang of a tool of this kind. The next operation is to machine the cellar fit with the special tool shown in Fig. 7, both sides being machined at one time. This tool is very simple in design and is of heavy construction to take care of the long overhang.

Next, the boxes are recessed on the boring mill to accommodate the collars on the crown brasses and then the brasses, which are turned on a special mandrel, are pressed in. The boxes are then planed ¼ in. below finished sizes, and are dove-tailed, grooved and bronzed, these operations being the same as for the old boxes and using the same jigs, tools, etc. After the boxes are dove-tailed the anchor holes are drilled and countersunk from the inside. Spring saddle seats are milled on all boxes to insure the spring rigging being level.

When pressing in crown brasses a pressure of from 15 to 25 tons is applied, depending upon the size, construction and general design of the box. No boxes are opened up with spreaders prior to applying crown brasses, as it has been found that this is not good practice. All crown brasses are machined to fit the boxes properly, no brasses are shimmed when new and special attention is given the fits on the lips of the crown brasses to insure proper radii on corners. No plugs or pins are used as retainers for the crown brasses as it has been found that it is not necessary to use them when the brasses are applied with the collars, or flanges.

Conclusion

The material used on new work is drawn from the storehouse and is delivered to the machine shop by the trucking system and the men who do the driving box work do not lose any time in going to and from the storehouse for material. This is an important feature in connection with the handling of this work, which keeps the men on the job and saves time. The tendency for men to walk around the shops from place to place for material, etc., can be eliminated by bringing material, sizes, reports, tools, etc., to them.

Analyze your driving box work, look around and see what

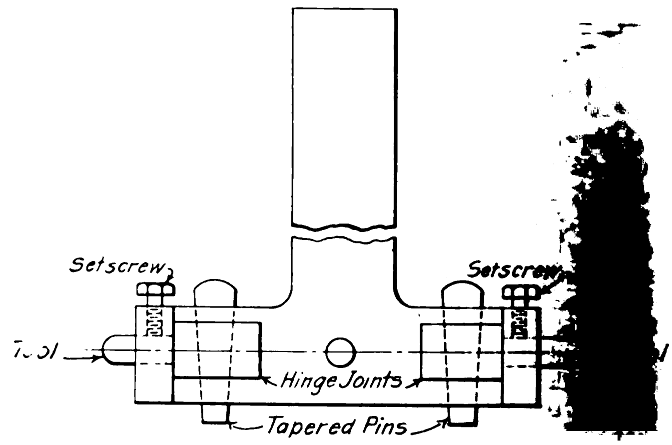
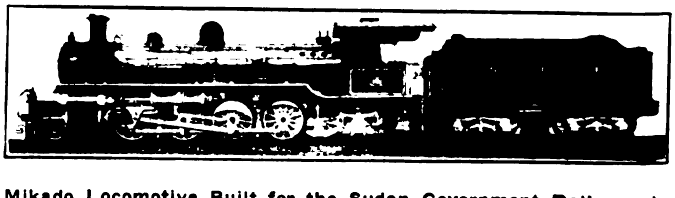


Fig. 7—A Simple Tool Designed to Machine Cellar Fit in Both Sides of the Box at One Operation

the other fellow is doing, see the results that he is getting and compare the number of engines you handle, the facilities you have, the number of men employed on this work and the source of supply for material for doing the work, and then work out a systematic method for handling the work. All these factors enter into the establishment of a well-balanced driving box gang. We should not say establishment, however, as this word is out of place in railroad shop practice. We do not establish anything, we start it and progress or go backward, and if you are not progressing with driving box work it is certain that you are going backward.



Mikado Locomotive Built for the Sudan Government Railways by Robert Stephenson & Co., Ltd., Darlington, England; Gauge 3 ft. 6 in.

Application of Micrometers in Railway Shops

Interchangeability of Locomotive Repair Parts Is Made Possible by Using Accurate Measuring Devices

Part II

By M. H. Williams

LOCOMOTIVE repair work is peculiar owing to the fact that the men must change from one job to another several times a day. Owing to the wear of certain locomotive and car parts it is necessary practically to machine each repair part to fit into worn parts that are of different sizes. As a result, there are very few duplicates handled per day. This lack of duplication, which is a necessary evil that cannot be avoided, serves to bring out the fact that careful consideration should be given to the small hand tools, shop kinks and micrometers, in order to reduce all possible lost time when measuring, traveling from the machines to the locomotives and the hundred and one little delays that eat up time.

Measuring a Crank Pin with a Micrometer Caliper

It is becoming more and more the practice in railway shops for certain designated men who may be known as gang foremen, inspectors or checkers, to inspect the worn parts of the locomotives and pass on the grading and necessity for making repairs. These inspectors in many cases measure the worn parts and mark on prepared blanks the sizes to which the new or repaired parts should be finished. These blanks are handed to the machine operators who finish the repair parts to the sizes called for. The added cost of these inspectors is discounted several times over, by the decreased cost of machine work and fewer spoiled parts.

Locomotive repair work, as is well understood, calls for several classes or kinds of fitting. Axles and bushings must be forced off and shrunk into place and may be, depending on the nature of the material, anywhere from .002 in. to .020 in. larger than the hole. Valve motion lever pins are generally between .003 in. and .006 in. smaller than the bushings and driver boxes are bored about .020 in. larger than the axles. By providing the necessary measuring instruments, gages, micrometer calipers, etc., for both the inspectors and the machine operators, the required drive, neat, running or loose fit can readily be made by the workman from the sizes shown on the blanks without going to the locomotive or place where the part so finished is to be used.

In order that a man in one part of the shop shall be in a position to make an article that will properly fit in the locomotive frame, wheels, or air brake equipment that may be in another part of the shops, the measuring devices must be accurate, of a nature not requiring any particular skill in their use and of light weight so that the inspectors may readily carry the necessary equipment from one point in the shop to another.

Measuring Locomotive Driver Axles and Boxes

In certain railway shops, the art of boring driver box shells or crown brasses such as used for repair work has been so perfected that it is not necessary to scrape, file or spot the driver box on the axles. The side wearing surfaces are machined to the correct dimensions at the same time as the boring operation. This, as will readily be noted, saves considerable labor and delay. With some of the modern driver box boring mills the boxes are bored and faced to correct dimensions without delaying the machine operation for the purpose of measuring. The only measurements made are after the completion of the finishing cut which is for the purpose of checking the correctness of the work. In every day repair practice where scarcely two journals are of the same size, practically all boxes are bored within a limit of plus or minus .005 in. of the desired size. This desirable practice has been made possible owing to the use of micrometer calipers, special micrometer gages and micrometer dials on the boring mills.

The operation of measuring the diameters of axles and the distance between wheel hub faces is as follows. When inspecting the axles, the diameter of the journals are measured with micrometers, preferably similar to that shown in Fig. 1, although the regular micrometers without the additions for squaring are frequently used.

When the wheels arrive in the wheel shop, if the journals are not cut or rough, the inspector measures the journals to ascertain the amount they are worn out of round or tapered for the purpose of determining as to the necessity of returning or passing. If a single journal is in good condition and less than .030 in. out of round or tapered, it would be considered satisfactory for service. If this limit has been exceeded returning would be necessary. The limits may be any amount that is established for any particular shop or class of locomotives.

Where the micrometers shown in Fig. 1 are used, the gage points *C, D, E* or *F* located on the frame, are set for the proper diameter. The micrometer is placed over the journal and the micrometer screw adjusted for the largest diameter of the journal and the size read. The micrometer is then rolled around the journal until the smallest diameter is found,

when a second reading is made. This is repeated for both ends of each journal. If readings are within the prescribed limits the journal is passed, if not, the journal is returned. This offers a quick and accurate method of determining if the variation due to wear is within the limits. If a journal is within the limits, the size at its largest diameter is recorded on a special blank for that purpose. Where the journals are returned, their sizes are measured after returning, for the double purpose of checking the accuracy of the turning operation, and recording on the blanks.

This method of measuring has the advantage of showing if the journals are within the prescribed limits as the axle comes to the shop for repairs, or after the turning operation. In other words, the inspector can settle the question of returning or passing with accuracy, which is much more reliable than by the sense of feel with machinist's calipers. In addition it removes the personal equation, which an inspector generally welcomes.

The distance between wheel hub faces are readily measured with inside tubular micrometers such as are made for the trade by one of the leading tool making concerns. This distance is also recorded on the blank. For this measurement it is customary to obtain inside micrometer calipers differing by one inch steps.

Measuring Bore of Driver Boxes

To measure the bore of a driver box shell, or crown brass, with machinist's calipers, or any two-point caliper, presents difficulties owing to the shells in many cases being less than a half-circle. In the September, 1920, issue of the *Railway Mechanical Engineer*, a three-pronged micrometer gage was described and illustrated and is here again shown in Fig. 2. Quoting from that issue: "The three prongs *H*, *H*, and H^1, are forced outwards by the descent of the taper plunger *G*, that in turn is controlled by the micrometer head *E*, the diam-

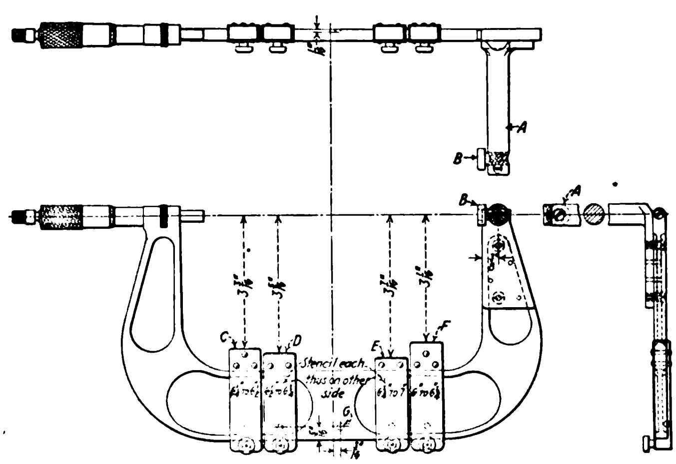


Fig. 1—Micrometer Caliper with Special Attachment for Measuring Wheel Seats on Axles

eter being indicated by the readings on the micrometer dial similar to the method of reading instruments of this nature." It will be noted that the three points cover a range of 140 deg. Therefore, a shallow shell may be measured. This caliper gage can readily be made in a railway tool room, the principal requirements being close fitting and the proper angle on the plunger *G*. For the purpose of testing, cast iron or boiler steel ring gages are made to sizes varying by exactly one inch. When testing the accuracy of the finished product, the gage is made correct at the smallest and largest range. That is, a gage having a range from seven to eight inches would at time of manufacture be made so the micrometer head will read zero in the seven-inch ring and one inch larger in the eight-inch ring gage. These ring gages are also used for master gages for the purpose of checking the three pronged gage in everyday practice.

Setting Boring Mill Tools

When setting the cutting tools in a boring mill equipped with micrometer dials or where an adjustable boring bar having a micrometer dial is used, it is the practice to set the tools approximately correct, make a trial bore approximately one inch deep on a driver box, and measure the bore with the micrometer gage shown in Fig. 2. The micrometer dial on the machine or on the boring bars is then set to agree with the gage reading, or the difference between the dial reading

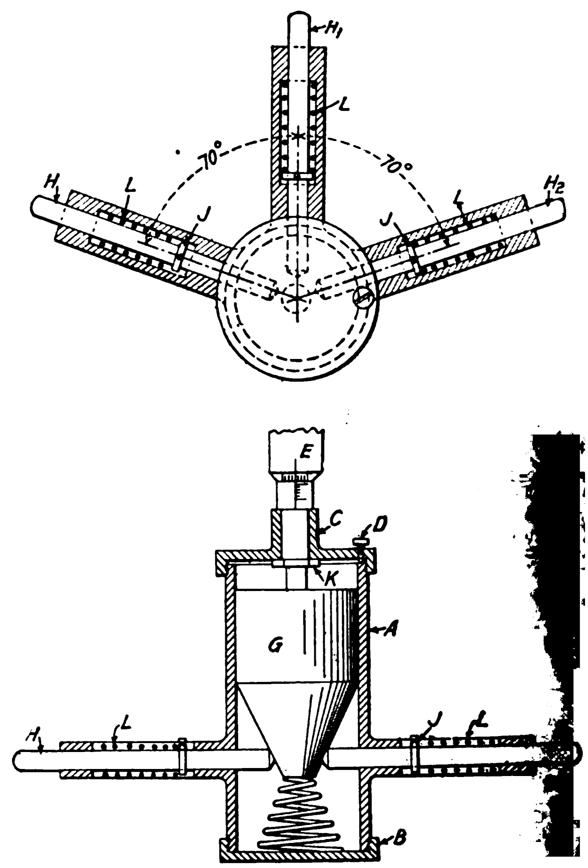


Fig. 2—Three Pronged Micrometer for Measuring Crown Brasses

and the actual bore is noted. If the machine is equipped with separate roughing and finishing cutters, the dials are set for each. After properly setting the dials on the mill or boring bars, the varying diameters of the boxes encountered in every day practices are readily bored by simply turning the saddle screw or boring bar screw so that the dials indicate the correct size and following up the wear of cutters by readjustment of the dials.

As previously mentioned, the sizes of the journals are recorded on a blank. The boring mill operator rough bores the shells about .040 in. smaller than called for on the blank and then finish bores the required amount larger than shown on the blank, or larger than the axles. After completing the boring, the diameter is measured with the micrometer gage for the purpose of checking the accuracy, which is the only measurement of the bore of the shell required. This eliminates stopping the boring mill for the purpose of taking measurements.

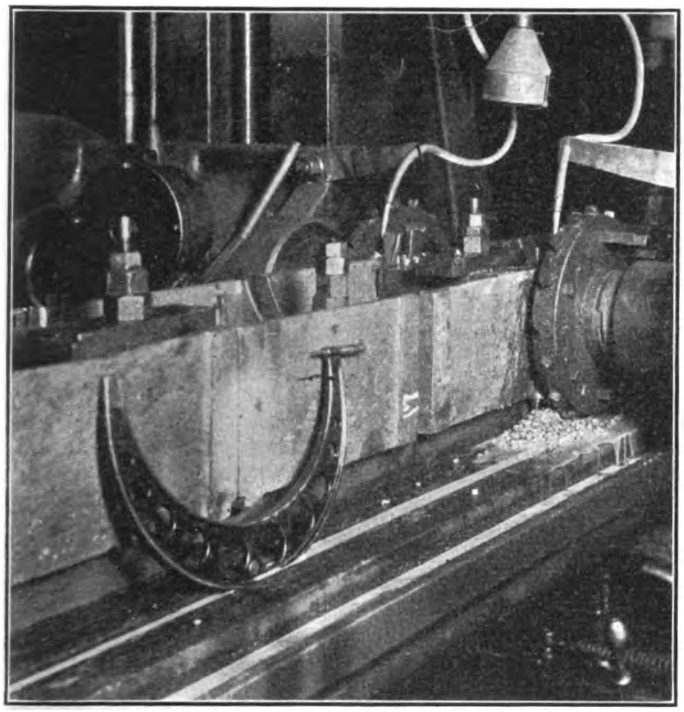
The operation of setting the tool for facing the box is as follows: The distance between the driver wheel hub faces as recorded on the blank is noted. One-half of the amount that this distance may vary from the standard is added to, or subtracted from the distance between the box side wearing sur-

face and the space on the box for shoe and wedges. If the distance as measured between the wheel hub faces is, owing to wear or refacing, .250 in. greater than standard, .125 in. is added when facing the box. Generally when setting the facing tool the distance from the shoe and wedge space to the point of the tool is measured with a rule. If greater accuracy is called for an inside micrometer is used.

Actual experience has shown that where micrometer calipers are used and with a modern boring mill arranged for box work, boxes to the different diameters encountered in repair work are bored, faced, filleted, sharp corners removed from ends of shell and cellar bored about 1/16 in. larger than the axle in 15 minutes from floor to floor. Or on an all day run of eight hours, 24 boxes are readily bored, faced, etc. This large output is made possible owing to the fact that the machine work is delayed less than ½ minute for each box for the purpose of taking measurements.

Fitting Bushings Properly

When replacing piston valve bushings, it is quite essential that the bushings shall properly fit the bores of the cylinders. If the bushing is too large it is difficult to force it into place, and if too small, steam leaks may result. One of the unfortunate conditions encountered in repair work in connection with fitting bushings, is that the bore of cylinders may not be a true circle. This irregularity may result from the springing of the cylinder when removing the clamps at the time of boring; the effects of heat warping the casting, etc. In order to fit new cylinder bushings properly the out of round condition of the cylinders should be taken into consideration and the bushing turned to meet the average conditions. In order to overcome this condition the cylinder bore and bushings should be measured for average diameters.



Micrometer Caliper Used When Repairing Driving Box Cellars

The bore of the cylinders for the piston valve bushing can best be measured with tubular inside micrometer calipers. The practice is first to determine the largest diameter, make a memorandum of it, and then measure to find the smallest diameter, and also record it. These two sizes are added and divided by two, which gives the mean diameter. That is, if the largest diameter is 15.860 in. and smallest 15.850 in., the two added together and divided by two will be 15.855 in.

Measuring cylinders in this manner has the advantage of obtaining accurately the average mean diameter and is a quicker method than measuring with machinist's calipers. In a large shop where locomotives are distant from the place where bushings are turned, one inspector can measure all the cylinders and give the sizes to the lathe hand who turns bushings, thus avoiding any delay to the lathe hand. In the smaller shops, the lathe hand measures several cylinders at one trip.

The commercial outside micrometers have been found very satisfactory for making measurements when turning the outside of piston valve bushings. The practice is to turn the bushings a certain number of thousandths of an inch larger than the mean diameter of the cylinder bore to allow for the desired amount of force fit. The amount larger than the bore will vary according to shop practices, which should be about .005 in. larger than the bore, the limits either way not exceeding .002 in. This may appear to be a close limit for cast iron bushings 12 in. to 18 in. in diameter. However, where micrometers are used, the workmen acquire the ability of measuring and turning, and thus readily meet these limits.

Considering the fact that these bushings must be steam tight in the cylinders, that an improper fitting bushing often necessitates its withdrawal when partly applied, and that measuring the cylinders saves time, the micrometers are a good proposition for this work.

Inside micrometers are also useful for measuring the amount of wear of the inside diameter of piston valve bushings. Where limits have been set governing this wear, measurements with these instruments at once show if the limits have been exceeded, and as a result the inspector can mark the bushings ready for reboring or renewal.

Cylinder and Piston Heads

When a locomotive is stripped and the surface of the bore of the cylinder is found to be in a good condition, the question of reboring or passing should naturally be governed by the amount of wear or difference in the diameter of the bore. Good practice also indicates that there should be a limit governing the bore where a locomotive is undergoing heavy repairs. It is a question if the cylinder should be rebored where the difference in the diameter of any two measurements of a single cylinder does not vary more than .032 in. A greater allowance should naturally be made for running repairs.

When cylinders are rebored they at times are found to be larger at one end than the other, which may result from defective boring bars, wear of cutting tools and other causes. Good practice also indicates that limits should be set to govern this condition. It is a question if this limit should be less than .010 in. as the packing rings should take up this amount without excessive wear in the grooves of the piston heads. Cylinders, where the bore has been found true, must be measured in order to turn the piston heads and packing rings.

All of the above mentioned measurements are quickly and accurately made with tubular inside micrometers. It is the practice for the inspector to measure the cylinders which have not been rebored at different locations and angles, and from the result of these measurements to mark the cylinders for reboring or passing. The micrometers at once indicate if the required limits prevail, fully as well as would be the case if it were possible to make use of snap limit gages.

The amount a piston head should be smaller than the cylinder bore has not been clearly defined. Practice appears to indicate that for cylinders up to 30 in. diameter the piston should be about .032 in. less in diameter, subject to a tolerance of plus or minus .010 in. The decimal meas-

urements of piston heads assembled on the rods are easily made with the sliding or adjustable micrometer. From the inspector's list of cylinder diameters, the amount the piston should be smaller than the cylinder is subtracted and a list showing the required diameter for each piston head with the locomotive number is handed to the lathe hand, who turns the piston heads to the diameters called for.

Advantages

It has been the practice when measuring the diameter of the cylinders for piston valve bushings for the lathe hand to go to the locomotive where he either sets machinist's calipers for each bore or makes use of adjustable pin gages. Where the bore is out of round an estimated allowance is made for this condition. Cylinder bore measurements are made by a number of methods, such as setting a separate pair of machinist's calipers for each cylinder and then measuring with another pair of calipers and transferring this measurement to a rule and recording the size on a memorandum, using adjustable pin gages, etc. All of these generally make it necessary for the lathe hand to leave his station for each cylinder for the purpose of measuring which results in considerable delay to the lathe. Where more than one measurement is made on a trip, several gages must be carried along.

By the use of micrometers an inspector measures all cylinder, piston valve and bushing bores before and after repairs, indicates the amount of repairs and makes the necessary memorandum of sizes for the use of the lathe hands. As a result the lathe hands working on piston heads and piston valve bushings do not leave their machines. As these tubular inside micrometers are light and small in diameter, the inspector readily carries the full complement necessary to meet all requirements for different diameters of cylinders and piston valves.

The inspector may at first glance, in some of the medium sized shops, look like an added man. The term inspector does not necessarily imply that he shall be confined entirely to cylinder work. Where the cylinder work is not sufficient he can also measure axles, crank pins, or any other work requiring accurate measurements.

A question may be raised as to the advisability of one person measuring the cylinders and a second measuring the turned piston valve bushings and piston heads from a memorandum of sizes made by the first person, because of the divided responsibility. In actual practice, it is found that errors rarely occur, partly, owing to the fact that the micrometers measure exact sizes and also the memorandums of sizes become a record, where, in the event of errors, it is referred to and the blame placed on the lathe hand or the inspector responsible. One of the greatest advantages results in the toning up effect on the men. Where a size in decimals is given to the lathe hand he, as a general rule, is anxious to finish his part to the sizes called for with the least amount of error.

Valve and Piston Rods

For repair work, the actual diameter of a piston or valve rod is of minor importance, providing they are not above the maximum or below the minimum allowable diameters. It may look like extravagance to recommend micrometers for this purpose. It is, however, very important that the section of the rod which passes through the metallic packing shall be of one diameter for the entire distance owing to the fact that the metallic packing, now generally used, will not accommodate itself during each stroke to the different diameters where they exist in a single rod. If a nominal four-inch rod has been worn or refinished to 3.896 in. this diameter should prevail for the entire packing ring surface.

Owing to the weight, length and the possibility of the springing of these rods during the time of repairs, it is somewhat difficult and expensive to machine to one actual diameter from end to end even on the most modern grinding machine. Practice and shop output would indicate that a tolerance should be set to govern the difference in diameters of a single rod. It is believed, however, that when balancing the wear of metallic packing and the possible steam leaks against the added cost of finishing, this tolerance should not exceed .003 in. That is, for the undersized rod the diameter at one end could be 3.896 in. and the other end 3.893 in. without serious detriment. About the only practical way of measuring this tolerance is with outside micrometers, and as three or four sets will answer for practically all piston and valve rods, their use is to be recommended.

One advantage of micrometers as compared with machinist's calipers is the ability to inspect, measure and read the actual difference in diameters. The greatest advantage will be derived because the machine operator, when making use of these instruments, is in a position to measure the actual difference in diameter, and he will gradually work up to a higher standard which will eventually result in finishing these parts well within the tolerance mentioned.

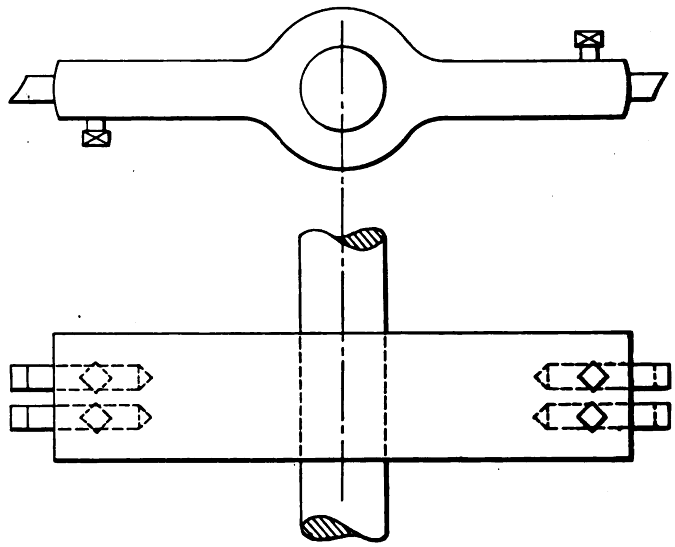


Fig. 3—Non-Adjustable Boring Bar Head for Truing Up Piston Valve Bushings

Piston Valve Parts

There are a number of designs of piston valves and parts and, therefore, no general method can be advanced for measuring all of the parts that go to make up the completed article. When repairing piston valves, the parts on most designs can to a large extent be brought back to certain standards and limits which in most cases will reduce the time and the cost of machine repairs. As an illustration, it is entirely practical to establish step sizes governing the bore of piston valve bushings and correspondingly the diameter of the packing rings. They, as well as bull rings and spools on most designs of valves, can at times of repairs be brought back either to the original sizes or to limits varying from the required sizes an amount that will not interfere with the proper working of the valve.

In a number of shops it is the practice after applying piston valve bushings to bore to standard sizes such as 12 in. and 14 in. When repairs make it necessary to rebore, it is the general practice to bore 1/8 in. larger than the standard size. Packing rings are kept in stock which are cut to a suitable diameter for any of the standard sizes of bushings. The thickness of the rings is made correct for a running fit in the piston valve grooves.

Good practice indicates that piston rings should be from

.002 in. to .004 in. less in thickness than the piston grooves. It is evident that where the rings are machined to the proper diameter they will fit correctly bored bushings without waiting for the wearing in process. With proper measuring instruments and boring bar heads the diameter of packing rings and the bore of piston valve bushings can readily be made entirely interchangeable.

Boring Bar Heads

It is the practice in some shops to make use of the non-adjustable boring bar heads when boring piston valve bushing while in place in the valve chamber. A separate head is used for each step size of bushing, which multiplies the number required. However, their cost is comparatively low,

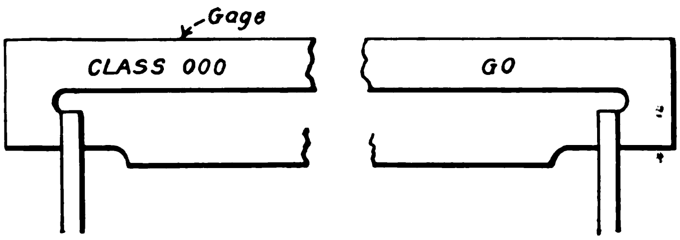


Fig. 4—Solid Gage Used to Measure the Limits When Making New or Repairing Old Piston Valve Spools

and considering the saving in time when boring the bushings and also the saving as a result of interchangeability, these heads are a good investment.

These heads, which are generally used on the regular commercial cylinder boring bars, are made in a number of forms, one of which is shown in Fig. 3, which shows two sets of two cutters set 180 deg. apart. The cutters are held by set screws, to guard against accidentally shifting. Liners are placed at the bottom of the cutter sockets in which the cutters are held. As the cutters are sharpened, additional liners are made use of to compensate for the decreased length of the tools. Previous to grinding, it is the practice to set the cutters outwards a sufficient amount to allow for the grinding. The head is then placed on an arbor and the cutting tools are ground on a cylindrical grinding machine similar to sharpening milling cutters. The measurement over the second or finishing cutters is to the exact size required, such as 12 in. and 14 in. The leading or roughing cutters are ground about .010 in. smaller, such as 11.990 in. and 13.990 in. The size over the cutters is measured with micrometers.

The advantages of non-adjustable cutter heads when compared with adjustable heads where the tools must be set for each size, are that the cutters are sharpened in tool rooms where the men are accustomed to close work; time is saved in the erecting shops and engine houses by eliminating tool setting and, principally, accuracy of the bore is insured, which makes interchangeability possible. While measuring devices in connection with the boring heads are only secondary, the accuracy of grinding is very essential in order to obtain the desired results.

When blanking out piston valve packing rings, in a number of shops it is the custom to rough turn the outside surfaces. The bore and width, however, are made to the required dimensions. After completing the blanking out operations, the rings are cut, compressed so the openings are reduced to about 1/16 in., and while in the state of compression, are clamped on their sides in a special arbor. The rings are then turned or ground to the required diameter. The measurements of the diameter are made with outside micrometers in order to insure accurate workmanship and interchangeability. The width, at the time of machining, is measured to good advantage with micrometers. The latter limits, as mentioned above, are between .002 in. and .004 in. less than the width of the groove of the piston valve.

Gages for Piston Valve Spools

Piston valve spools generally wear on the end surfaces which rest against the packing rings. This makes it necessary to refinish these surfaces which reduces the distance between the packing rings and, sooner or later, a point is reached where the valve will not function properly owing to this reduction. When making repairs, the spools, when only slightly worn, are refaced, or, if too short, the original length is restored by autogenous welding or by welding sheet metal rings to the end surfaces, after which they are faced to the original length. In order to govern the kind of repairs required for each valve, limit gages have been used to good advantage.

The amount of limit allowable has not been clearly defined and will naturally vary with different classes of power and individual opinion. It is, however, a question if a valve spool 1/32 in. less in length than the standard will not affect the operation of the locomotive, and this is mentioned as a limit to govern the amount a spool can be faced at the time of making repairs. When making new spools, or where spools are built up on their ends, without calling for too close and expensive workmanship, they are readily faced to a limit not exceeding .002 in. plus or minus. In other words, a new spool having a nominal length of 24 in. can be between 24.002 in. and 23.998 in. in length, and when refaced is between 24.002 in. and 23.968 in. long. To govern these limits solid gages are often used. Fig. 4 shows a form suitable for this purpose. Three are required for each class of spool which are the maximum and minimum for new and built up spools, and the minimum for repaired spools. This often makes it necessary to provide a number of gages. However, when making new spools or repairing spools, the workman, having the limit gages as a guide, will eventually produce a more uniform distance between the packing rings and correspondingly better working valves. As a substitute for the numerous gages mentioned above the sliding micrometer can be used to good

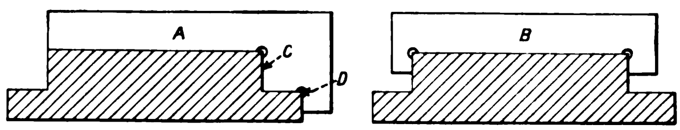


Fig. 5—Gage for Measuring Packing Ring Space in Piston Valve Bull Rings

advantage. When using this instrument printed instruction should be placed in the hands of the workmen

Bull Rings

When making or repairing bull rings it is quite important that the packing ring space shown in Fig. 5 at *C* and *D* shall be correct in order that the rings may move freely and without an excessive amount of side play. The solid gages shown in Fig. 5 have proven very satisfactory for this purpose. The distance from surfaces *C* to *D* on the gage agree exactly with the width of the packing rings. For ½-in. packing this dimension is exactly that amount. In operation the gage is placed on the outside of the bull ring. When in this position errors as small as .001 in. are readily detected. The gage shown at *B* is for measuring the overall width of bull rings. Two of these gages constitute a set, one for the new bull rings and a second having an opening agreeing with the allowable decreased width such as used for repaired parts.

Advantages of Gages and Measuring Devices

By providing the workmen with suitable gages it has been found that they will readily machine the various parts of

the piston valves to the limits called for without consuming an increased amount of time, and, as the parts are all interchangeable, the valves are assembled without individual fitting with the corresponding reduction in time. By boring piston valve bushings to step sizes, the valves become interchangeable with the bushings, and as a result the valves may be repaired in quantities and kept in stock. One of the advantages well worth mentioning is that of allowing the correct amount of side play for the packing rings when assembled in the valves which is readily obtained by the interchangeable manufacture or repair of parts.

Cleaning Out Air Pumps

An effective device for the periodical lying out of air pumps, used at the Albuquerque enginehouse of the Atchison, Topeka & Santa Fe, is shown in Figs. 1 and 2. In order to maintain these air pumps in efficient operation it has been found necessary to clean the air cylinders thoroughly once in three months. This cuts the old oil and lubricant from the air cylinder walls and to a certain extent at least removes the carbon which has formed in air ports and passages. The benefit of this cleaning operation was found to be sufficient to justify removing the air pumps

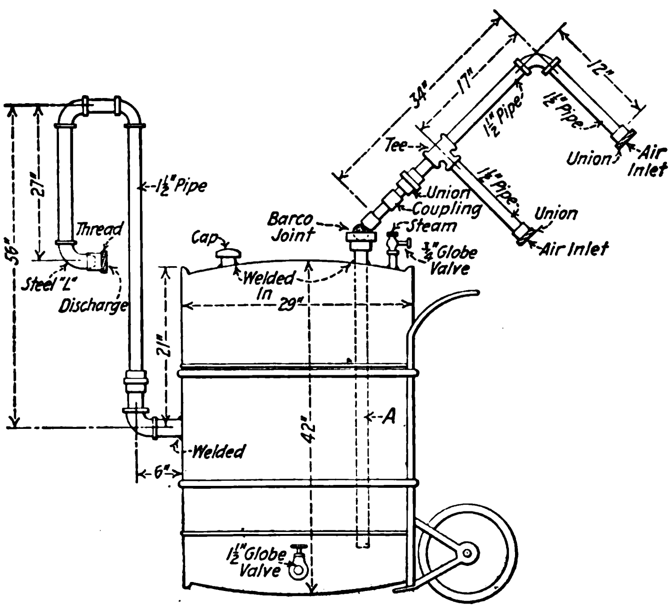


Fig. 1—Apparatus for Cleaning Out Air Pumps

at three months' intervals but by means of the apparatus illustrated in this article, the cleaning operation can now be performed just as well without removing the pump from the locomotive.

Referring to Fig. 1, the construction of this simple apparatus may be described as follows: An oil barrel 29 in. in diameter by 42 in. long is mounted on a pair of truck wheels with handles for convenient movement about the enginehouse. Pipe *A* extending nearly to the bottom of the barrel, is welded into the top head to make an air-tight joint and arranged with suitable pipe connections and a Barco joint, enabling the pipe to be connected to both inlets of the air pump. The small ¾-in. globe valve at the right of pipe *A* is for the admission of steam to heat the water and lye solution. The air pump discharge is piped to the middle of the barrel as shown. A cap for filling is welded in the top head of the barrel and a 1½-in. globe valve for cleaning out is provided at the bottom. The appearance of this apparatus after being connected up ready for operation is shown in Fig. 2.

In operation, the barrel is filled perhaps two-thirds full of a solution of lye and water which is heated and kept hot by steam from the blower line through the ¾-in. globe valve. The air compressor being started, this cleaning solution is drawn through the air inlets to the low-pressure cylinder. It passes to the high-pressure cylinders and is discharged back into the barrel where sediment and foreign matter settle to the bottom. A comparatively short operation of the pump

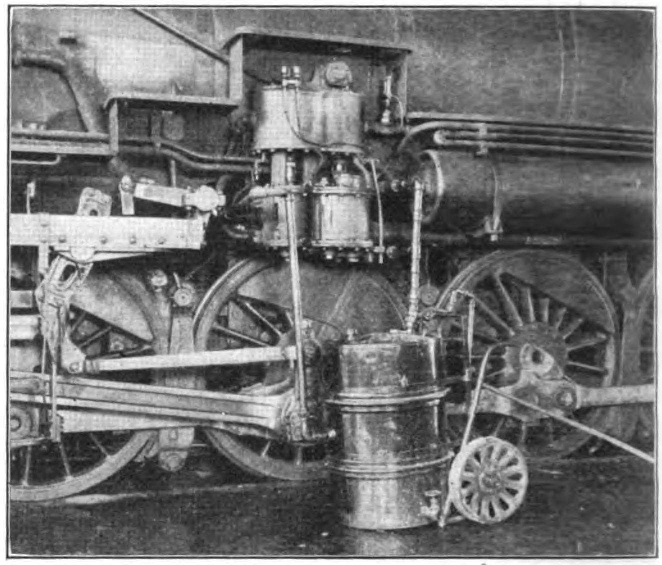


Fig. 2—View of the Clean-Out Tank in Operation

suffices to clean the air cylinders thoroughly, after which a supply of good, clean lubricant will again place the air pump in condition for efficient operation with greatly increased life of piston packing rings, and cylinder bushings.

Pitting and Grooving in Boilers*

In some districts in the United States and Canada, it has been found that corrosion, as evidenced in the pitting of flues, and the grooving of fireboxes, is a serious embarrassment in the maintenance of locomotive boilers.

The writer has had some experience of a general nature in these matters and has taken advantage of the opportunity of consulting with those who have had much to do with them.

Boiler metal corrosion is merely oxidation of the iron or its solution in water. Pure water will dissolve iron to some extent. That is the reason that absolutely pure water is not best boiler water. The presence of a little lime, in otherwise pure water, is frequently found to be a safeguard against this action and is, therefore, desirable.

The fact that this corrosion is evidenced in pits, or grooves, is due to lack of homogeneity in the metal of the parts affected. In other words, the boiler metal is not just alike in its qualities throughout its area. No commercially used iron can be pure, and steel is adulterated iron. If the other chemical elements used are not evenly distributed, we have metal of different tendencies at different points.

If absolute homogeneity were possible and were secured there would still be corrosion, under some conditions, but not in the form of pits or grooves and not for the three causes which are given below.

Causes

It is found that pitting and grooving take place in connection with the use in boilers of three distinct general classes of water evaporated, as follows: 1, pure water; 2, water

*Abstract of a report presented at the convention of the Master Boiler Makers' Association, held at Chicago, May 20 to May 23, 1924.

containing acids; 3, water containing alkaline salts, such as sodium sulphate, in excessive concentration.

Pure Water—It is a surprise to many to learn that absolutely pure water is not a good boiler water. Iron dissolves to some extent in pure water, and more rapidly in rain water, which is usually considered pure water. This is a fallacy, as rain picks up all sorts of impurities on the way down. Natural waters which contain small amounts of lime, as an impurity, are the best boiler waters.

Water Containing Acids—Mine waters usually contain sulphuric acid and since such water has to be pumped to clear the mines, it is frequently made use of for boiler supplies. Salt water frequently shows up hydrochloric acid (produced by reaction). This is met with by railroads near seashores and sometimes inland. The effect of either of these acids is to produce more or less rapid corrosion of the metal of the boiler, by acid solution.

Water Containing Alkaline Salts in Concentration—Where waters are very hard in sulphate scale and where a soda ash treatment is used to reduce this scale, sodium sulphate is a product of the reaction. This salt remains in solution in the boilers and concentrates as steam is evaporated off. This concentration seems to furnish the electrolyte for galvanic action, which means decomposition by stray electric currents. These currents travel between points of different electric potential always in the same direction and they carry off the metal with them.

Prevention

There being three general reasons for corrosion, as given above, it will be necessary, in attempting to prevent the condition, to first decide upon, and classify, the cause.

Any water which causes corrosion should be abandoned, if possible, and substituted with better water supplies. That is always the first consideration in attempting to improve boiler conditions. If it is impossible to get waters which are satisfactory in their natural state, then steps must be taken to change the nature of the waters which it is necessary to use, and which are troublesome. It would be best, however, to again call attention, at this point, to the secondary cause for pitting and grooving, dependent upon a general corrosive condition.

If boiler metal were entirely homogeneous; that is, if it were possible to have flues, for instance, with the metal exactly alike throughout their area, corrosion would not take the form of pitting, because if the reason for corrosion is acid action, it would be uniform throughout, and the flues would slowly dissolve away, in uniform manner. If, however, the cause of the corrosion is galvanic action, electrical couples would not be formed at different spots and again there would be no pitting, and in fact, in all cases, there would be very little corrosion of any kind. Therefore, under the subject of prevention, we must first consider metal quality.

It is generally believed that charcoal iron is more homogeneous than steel and that iron tubes are, therefore, more resistant to corrosion than are drawn steel tubes. Whether or not this is true, the writer is not prepared to say. It would seem as if steel could be made as homogeneous as iron and it is evident that if it were so made, it would be just as good.

Generally speaking, it is theoretically easy to draw conclusions as to the cure for corrosion in that the causes are so simple. The remedies suggest themselves when the causes are determined. In practice the matter is just a bit more difficult to handle in some cases. Acid action is stopped by alkaline neutralization. Galvanic action may be reduced by changes in the method of treatment, to prevent the concentration of sodium salts in the boiler, or by adding chemicals which will change its nature. Pitting and grooving can be reduced by obtaining more homogeneous metal.

Relative to the treatment of water, the railroad with which I am connected (C. I. & L.) has used polarized mercury chemicals for several years, and it is believed that this is one of the reasons why we are so little troubled with pitting and corrosion. In mine waters which we use in southern Indiana, acid action is prevented by the alkaline agents in this treatment. In other districts, notably the territory surrounding Lafayette, Indiana, at which point we are forced to use more and harder water than at any other single point on the line, the soda ash treatment was used several years ago, and abandoned on account of the necessity for using a very heavy treatment, to reduce all of the scale forming impurities. This caused foaming and probably was the cause of pitting, in that we had that condition, to some extent, in our boilers, indicating galvanic action.

The boilers operating in this district are using the mercury chemical treatment of somewhat different formula, from that used in the mine region. The mechanical action of the mercury assists the chemical action, so that the chemical treatment is never heavy enough to produce any great concentration of sodium salts in the boilers.

Moreover, it is noted that where this material is used there is a surface coating of a black glassy nature on the heating surfaces. This, I am advised, is a mercuric oxide of iron and is a good conductor of electricity. It seems logical to believe, therefore, that any lack of homogeneity in the iron is, to some degree, at least, offset by this surface coating which furnishes a pathway for the stray currents generated in the boiler; in other words, it makes a homogeneous surface or non-homogeneous metal, and that is all that is necessary under these conditions.

We are now getting very good flue mileages averaging around 75,000 miles for all classes of engines, and fireboxes are giving us proportionately good service. This is in what we are told is the hardest water district in the country.

This report was prepared by a committee composed of Lewis Nicholas, chairman; H. V. West and F. J. Howe.

Discussion

It was generally agreed during the discussion that pitting and grooving was not confined to one place. The degree and extent of this deterioration varied according to the chemical content of the water used in the boiler. It was thought that the problem was one for the chemist to solve. The prevention of pitting could be accomplished through the use of the proper chemicals determined by a thorough chemical analysis of the boiler feed water.

Locomotives in the Shops of Messrs Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, England, Awaiting Shipment to India.

Time Element Vital in Modern Blacksmith Shop

Master Blacksmiths in Convention at Chicago Discuss This and Other Important Phases of Their Work

ONE of the points brought out by the railroad master blacksmiths in convention last month at Chicago was the pressure under which they now work in meeting the time limits set on blacksmith work by short locomotive and car schedules. Corners must be cut and a full complement of modern shop machinery used in conjunction with all the modern welding processes and carefully trained operators in order to prevent cars and locomotives from being delayed in repair shops, waiting for blacksmith work.

While the modern blacksmith foreman has been largely relieved of the responsibility of frame making, his problem in repairing frames is greater now than ever. His duties in manufacturing tools and formers, dies and machine forgings have also increased. The program of this year's convention dealing with all of these and other subjects was highly instructive. It is to be regretted that only about 90 members of the association attended and benefitted by the reading of the papers and the subsequent discussion. Some of the papers presented at this convention will be abstracted in this and later issues of the *Railway Mechanical Engineer.*

The International Railroad Master Blacksmiths' Association decided to hold its 1925 convention in Cleveland. The following officers were elected for next year: President, J. J. Egan, N. Y., N. H. & H., New Haven, Conn.; first vice-president, H. W. Loughridge, P. & L. E., McKee's Rocks, Pa.; second vice-president, C. H. Nutter, B. & M., North Billerica, Mass.; secretary, W. J. Mayer, Michigan Central, Detroit, Mich.

Frame Making and Repairing

By J. H. Chancy

Blacksmith Foreman, Georgia Railroad, Augusta, Ga.

The steel foundries have relieved the smith foreman of what was in former years a great task, namely, that of frame making. Today, the smith foreman has as one of his major problems the task of repairing locomotive frames. Moreover, as blacksmith foremen we are required to do this work in a much shorter time than in the past when repairs were made in the smith shop. Considering the time allowed to get a locomotive back in service with proper repairs made we frequently find ourselves confronted with problems in running repairs that are indeed trying. In coping with these problems we need all the modern welding processes, one of which is usually best suited to the particular conditions accompanying each welding job.

On the Georgia Railroad we use the Thermit, oxyacetylene and electric processes. We find all of them successful when experienced operators are used in performing the work. If I were called upon to name the best process I would prefer naming the best operator.

We may have all overlooked to a certain extent the importance of properly trained operators for making welds with these new processes. Perhaps we are not to be too severely criticized for this oversight because we ourselves were inexperienced. In the old way of taking care of frame repairs the foreman ran no risk whatever in assigning it to his most capable and experienced men and in seeing that ample help was available. Many times he would take part himself when necessary. In those days success was certain but the same is true of the new processes of welding and I believe with the proper interest used in training our operators we are sure to realize our fullest expectations.

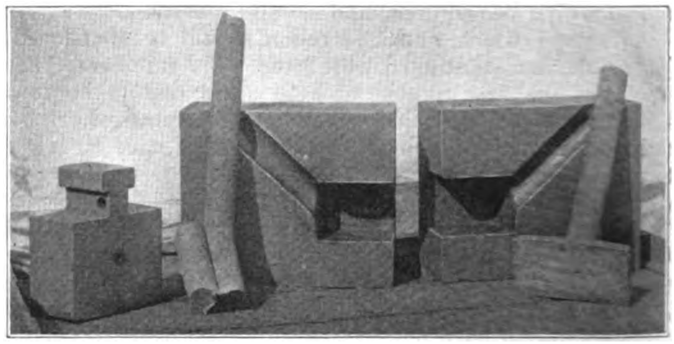
Appreciation should be accorded to the instructors in these new welding processes who from time to time have given us the benefit of their experience and faithful efforts. Not only have they helped instruct our men but in many cases they have given their own services and performed particularly difficult welding jobs themselves.

Carbon and High Speed Steel

By G. W. Kelly

Blacksmith Foreman, Central Railroad of New Jersey, Elizabethport, N. J.

The subject of carbon and high speed steel is such a broad one that this paper must be limited to the general application of these steels to shop use. Tool steel is one of the most important materials which come under our supervision. The writer will not attempt to compare the usefulness of carbon and high speed steel. The fact that a high degree of skill is required to get the best results from carbon steel has caused it to be superseded by high speed steel for many uses. For some kinds of work, however, carbon steel is equal and even superior to any high speed steel, provided it is dressed



Dies Used in Forging Smoke Arch Braces

properly and receives the proper heat treatment. For high speed work, however (and more and more of car and locomotive work has moved into this class), high speed steel is required to hold the temper under the heat conditions attending high speed operations.

Each year steel makers discover new alloy steels which are welcome in the blacksmith shop. This may be due to keen competition among the steel manufacturers but the result is a non-deforming steel which gives a uniform product by oil or air hardening. Such a product is particularly satisfactory in making reamers, taps, punches, dies, hard die blocks for forging machines and drop hammers and all hot working die blocks.

It is the writer's experience that, wherever possible, steel should be ordered cut to the proper lengths and annealed. In this way it is possible to route steel from the receiving department into the toolroom. In any case, the less forging steel received in the shop, the better. Steel may be forged at a higher heat than a hardening heat but it must then be annealed. The hardening and tempering thereafter are heat treating operations and in themselves form a broad subject.

The steel makers know their steel best, and give explicit instructions for the handling of their products. A study of their literature by careful workmen usually brings satisfactory results. To get uniformity of product in finished tools

we must have uniformity of steel and uniformity of operation throughout. To insure the same stock, great care should be exercised in marking each end of the bar at the steel mill. Labels are often made illegible in shipping. Each bar should be marked on each end.

Smoke Box Brace Dies

One of the odd shaped forgings on locomotives which occasionally break and require renewal is the smoke box brace. The dies illustrated were developed at the Elizabethport shops for making this forging, the operation being plainly shown in the illustration. Two and one-half inch round iron is used. After the iron is cut and bent over as illustrated, a soft heat is taken and the smoke box brace formed in one stroke of the machine. A five-inch Ajax forging machine is used for this operation.

Frame Sections Made of Scrap Axles

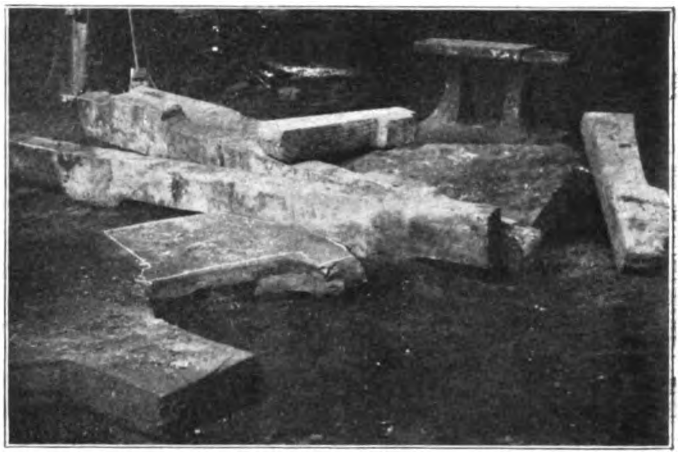
By W. F. Keller

Blacksmith Foreman, Michigan Central, Jackson, Mich.

Frame repairing on locomotives such as are going through railroad shops today is interesting work to all concerned due to the size of the frame and the necessary sections to be made and applied with the use of autogenous welding. The great feature in this connection is the cost of securing the necessary material for these sections, and the foreman in charge can use only the resources at hand. He must either buy bloom iron, or shingle the scrap and then slab it into billets large enough to make the parts wanted.

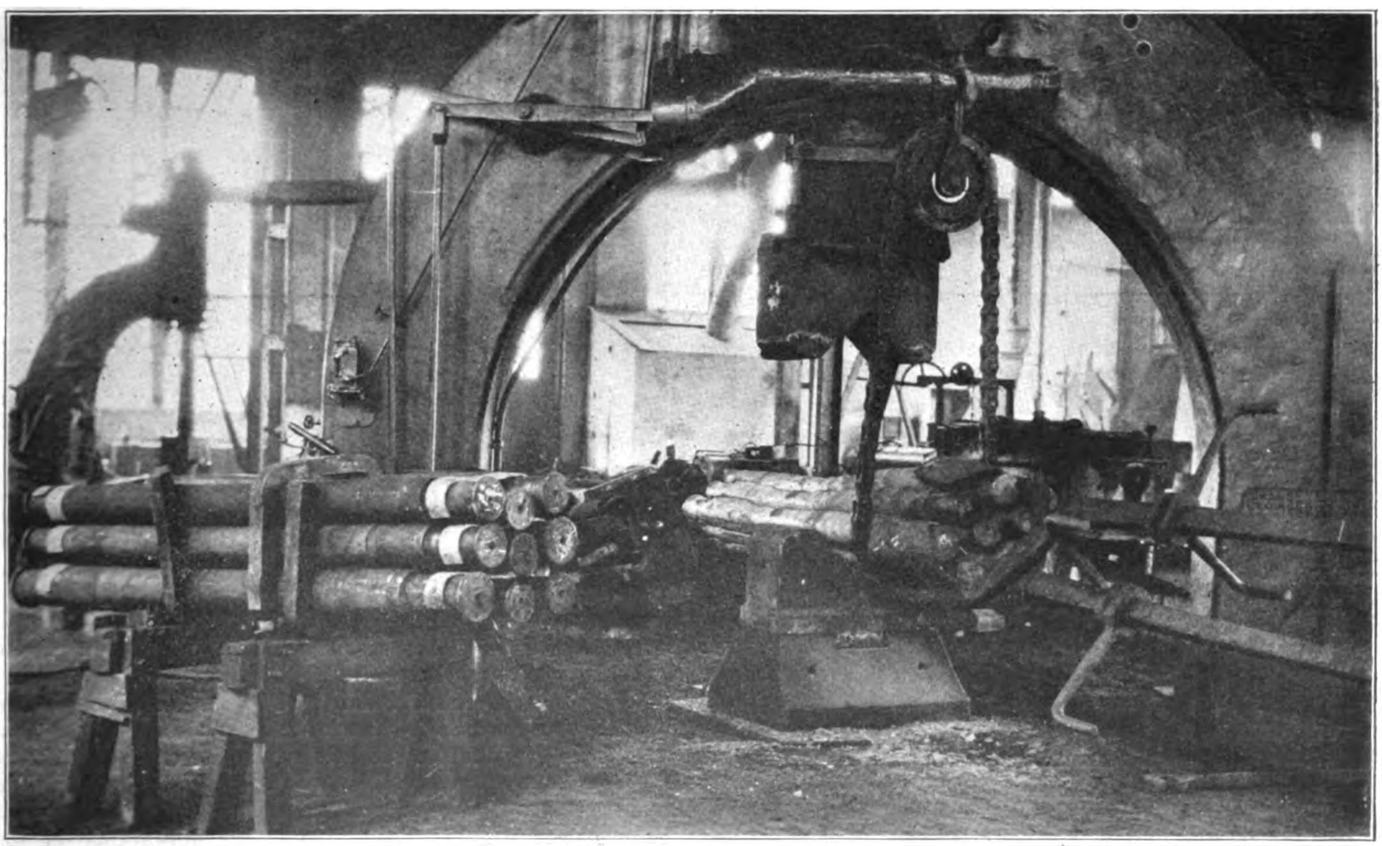
In the selection of this scrap we find that iron axles, 4¼ in. by 8 in., piled three wide and three high in their round state and welded into a billet as illustrated, can be drawn out into 12 in. square billets of good iron at a much smaller cost and in one-half the time required in getting the same material by the shingling process.

The axles are piled on horses inside of two yokes which keep them in shape until the straps of light iron are applied around the journals. This keeps them from spreading in the furnace while they are being heated. A special pair of tongs has been made for the purpose of handling the axles in and out of the furnace and under the hammer until the first end of the pile is welded. The pile is then picked up



Frame Sections Made From Axle Steel Billets

from the horses with the tongs, allowing the two yokes to remain on the horses. A third yoke, placed over the top of the pile just outside of the door while the axles are being heated, helps to keep the pile straight and square until the first end is welded. When heated properly the pile is taken out under the hammer and one end of almost half the length of the pile is welded and squared up in a pair of BV-blocks. The pile is then turned around and, with a pair of tongs that will take 12 in. square, the end to be welded is charged



Method of Handling Car Axles While Being Drawn Out Under a 4-ton Hammer to Form 12-Inch Square Billets

in the furnace, heated and welded without any further preparation.

In this operation a four-ton steam hammer and a two-door, 5-ft. by 8-ft. furnace are used. In eight hours we can weld four of these piles of axles which will give 14,400 lb. of iron in billet form of a quality very satisfactory for forging purposes.

Nine years of this practice has demonstrated that we can produce good iron very much cheaper and in less time than by any other method we have tried. Some of the frame sections made of these billets are shown in another illustration.

Autogenous Welding

By Joseph Grine

Blacksmith Foreman, New York Central, Depew, N. Y.

Autogenous welding has long since passed the experimental stage and has come to have a permanent standing in every day of business so far as the metal trades are concerned. It is no longer considered impossible to make any class of metal or mechanical repairs with the electric or acetylene welding method. The only factor that enters seriously into present day calculation is production. We no longer ask, Can it be done? But rather, How long will it take to do it? The answer to this question does not concern itself so much to the actual repair as with the preparation of the work previous to welding. For that reason this article deals more with the preparation of the work than with the actual repairing.

The main saving, it can be plainly seen, must be controlled by the amount of time and material saved in making the repairs. Thus in an earlier period it was the usual custom to remove the metal adjoining the breakage in any damaged member until the opening was approximately 45 deg. on a side or 90 deg. altogether. Today the opening is made only 60 deg. The saving in metal to be replaced can readily be seen and appreciated. Frames on locomotives that formerly took 10 to 13 hours to weld are now repaired in six to nine hours and apparently better welds are being made. They stand up longer and are neater and cleaner in every way. In the earlier days 12 in. an hour was considered fair speed for a good welder on locomotive boiler patches. Today we have operators that can easily produce 36 in. of side sheet welding without undoing the exertion. This is due to preparation rather than to the operator's skill. Side sheet seams are fitted closer and the edges are not so sharply beveled, thus reducing the space to be filled and at the same time giving a heavier welding surface to withstand the heat of the arc.

In many cases where continuous failures at any given point proved chronic, we have adopted the practice of removing a considerable area adjoining such breakage and applying a forging of the shape and size of the removed portion, welding it in on each end. This of course means double the welding at the time but as failures seldom recur after such treatment the consequent saving more than offsets the cost. There is little discussion at the present time concerning the various methods of making welds on any portion of a locomotive as most plants have established a method of their own to handle their particular class of work. Flue welding is possibly the only exception. Practically any method of flue welding as far as the preparation of the flue is concerned may be successfully accomplished by any careful operator except when water is in the boiler.

The temperature of welding metals at the time of application and of water at any time or temperature are so far apart that the hottest water has a chilling effect on the metal. Flues welded to a dry sheet will last as long as those applied with a water. Try a set. There is but one fair test to all things. Does it work? If not, all the theory of the ages proves nothing. The argument against welding a dry sheet of flues hinges on the fact that the flue sheet is heavy and the flue is light. No one seems to consider that the heating of the flue ~~feed~~ can be controlled by the operator. The amount of heat applied to a flue feed is just enough to cause it to unite with the welding metal. The highest point of the arc is concentrated on the sheet; the side radiation takes care of the feed. Our flues are dry welded and give the service that it is estimated they should, and more.

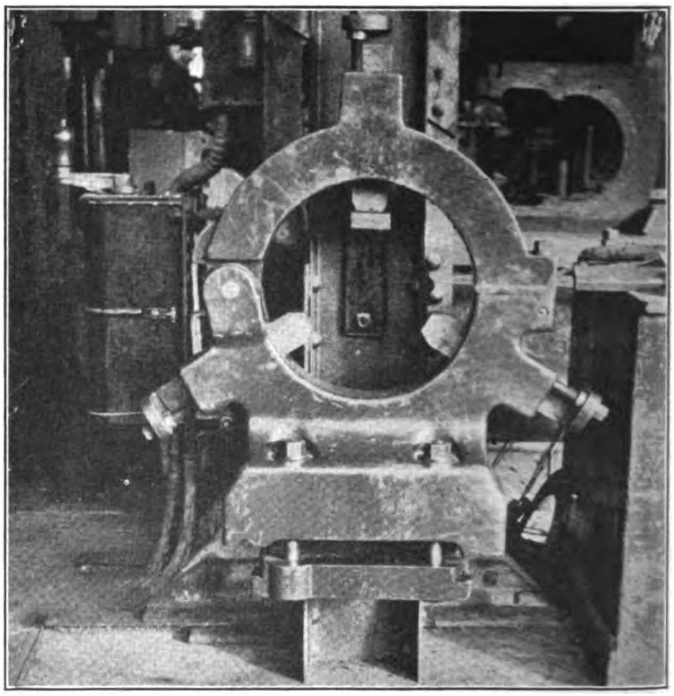
The human element is today our greatest problem—the training of men to do work as it should be done; training them to improvise to attempt things and methods for themselves, regardless of the fact that they may fail; trying to get workmen to have confidence in themselves and reduce the need of constant supervision.

Bracket and Post for Holding Lathe Steady Rest

By J. Robert Phelps

Apprentice Instructor, Santa Fe Shops, San Bernardino, Calif.

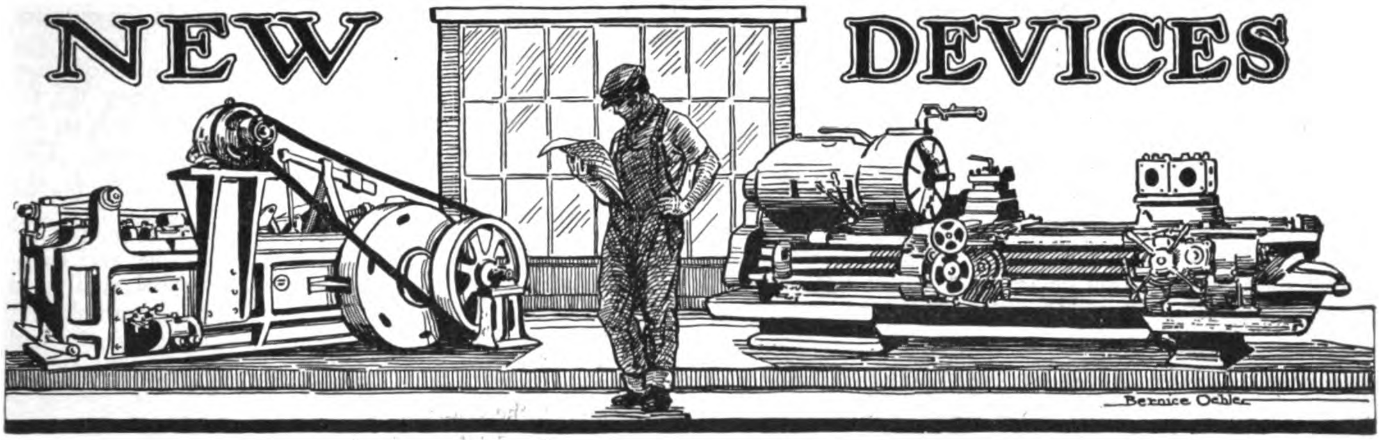
The illustration shows a convenient and easily arranged method of keeping a lathe steady rest off the floor which permits the floor readily to be kept clean. The bracket which holds the steady rest is made by bending a piece of 7/8-in. by 3-in. iron at right angles, and then electric welding on a piece of 3/8-in. round iron at one end to make a pocket 1 1/4 in. wide by 3/8 in. deep by 2 3/4 in. long for the top or



A Simple Method of Keeping Steady Rest Up Off the Floor

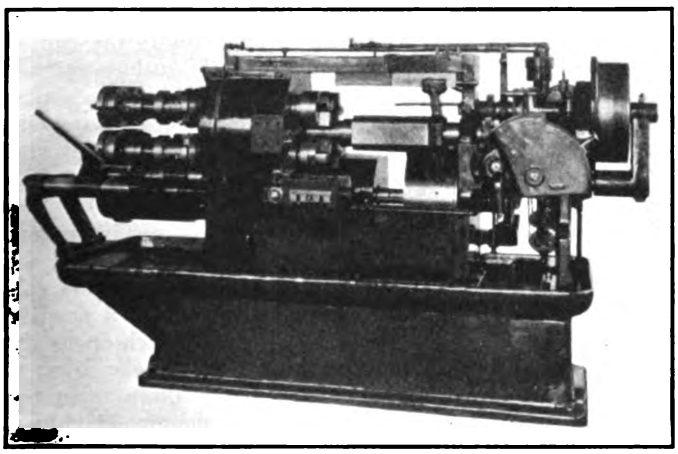
center bar of the steady rest to set in. It is then ready to bolt in place to receive the steady rest.

The pocket is electric welded to a piece of 1-in. by 3-in. channel iron, which is then set in cement. This gives a very rigid, light frame for holding the steady rest. As the average lathe steady rest is not a very pleasing object to look at when laying on the floor or in a dirty corner, this arrangement will do much to help the appearance of the shop.



Gridley Multiple Spindle Chucking Machine

TO meet the increasing demand for a production automatic machine capable of machining within precise limits numerous first and secondary operations in the shape of forgings and castings, the National Acme Company, Cleveland, Ohio, has lately added to the Gridley line a new model four-spindle machine of unique design. The basic design



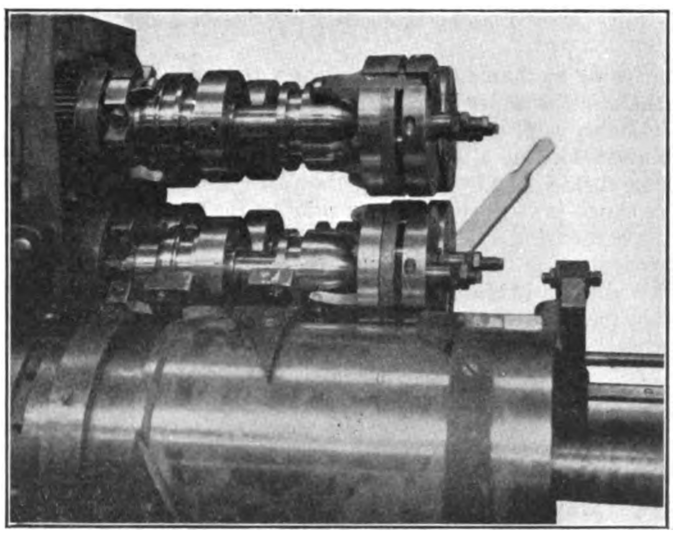
Gridley Chucking Machine with Mechanically Operated Chucks

of the Gridley multiple spindle bar machine is followed in the chucking machine. The latter also contains the Gridley turret arrangement, consisting of a spindle carrier with the turret slide on an integral stem, as well as the Geneva stop revolving mechanism.

The outstanding feature of the new machine is the chucking mechanism. This is built around the standard air chuck which has for many years been used in connection with Gridley single spindle automatics designed for chucking work. Mounted on the rear of each spindle is an air cylinder, the piston of which operates the draw bar back and forth. Behind the air cylinder is a four-arm spider casting fastened to, and revolving with, the spindle carrier. At the center of this spider is a swivel connection to which the hose from the shop air supply is coupled. From the point of this connection radial ducts pass through the four arms of the spider to the valve chambers. The valves themselves are revolving discs which in gripping position turn compressed air into the front of the cylinder to close the chucks, and in releasing position turn it to the rear of the spindle to move the piston in the opposite direction and open the chucks, at the same time releasing the pressure from the opposite end of the piston. The air enters the cylinders through swivel connections on their axes, which, in order to allow for any floating motion, are connected with the valves by heavy rubber tubing. The rotary valves are actuated by plunger racks sliding parallel to the spindle, and meshing in pinions on the valves stems. These plungers are normally kept pushed to the rear by coil springs, and while in this position hold the air pressure in the front of the cylinders, thus keeping the chucks closed.

This machine is designed so that one at a time its spindles are automatically stopped for loading, while the other three continue to run. When a spindle comes into the lower rear position, termed the fourth position, this mechanism comes into play to bring the spindle to a standstill, so that the finished work may be removed from the chuck, and a blank piece substituted.

This mechanism is very simple in construction. It consists of a special spindle gear free on the spindle, with a cone clutch seat in a large hub at the rear. Keyed to the spindle,

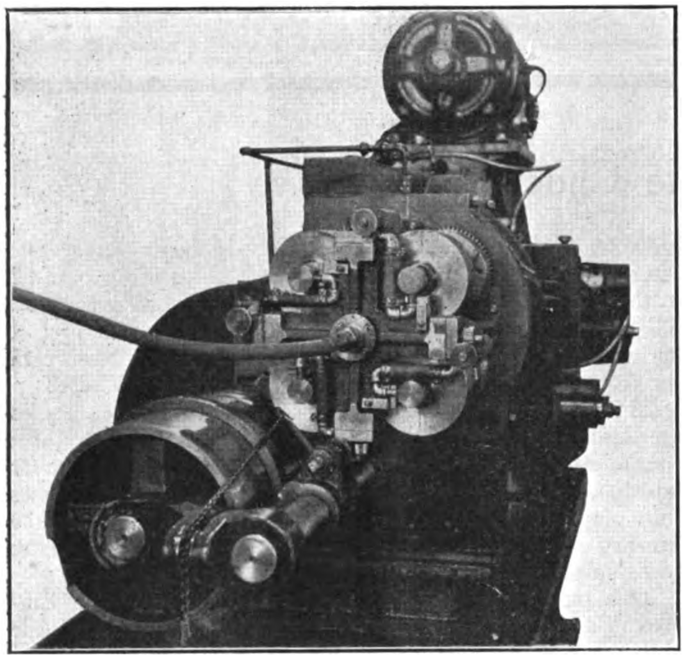


Spindles Equipped for Mechanical Chucking Where Air Is Not Used

and fitted into this cone clutch seat is a bronze clutch ring. Behind this clutch ring there is a special finger holder in which are pivoted three operating fingers, the front ends of which bear against the chamfered rear face of the clutch ring, while the rear ends work in conjunction with a clutch operating spool. Both finger holder and spool are keyed to revolve with the spindle. As the clutch operating spool is pushed forward, it spreads the fingers which in turn react upon the clutch ring to seat it into the spindle gear, thus driving the spindle. When the spool is withdrawn, the fingers collapse, and a set of spring plungers within the spindle gear unseat

the clutch ring, which disconnects the spindle gear from the spindle, and when the spool is withdrawn, its rear face bears against another set of spring pins in the back of the air cylinders which act as brakes to bring the spindle to an immediate standstill.

When any spindle comes into the fourth position, the following action takes place. A cam on a drum at the rear of the machine comes into play to move back a slide which in turn withdraws the clutch operating spool and stops the spindle containing a finished piece of work. As soon as the spindle stops, another cam on the same drum acts to move forward a similar slide which pushes down the plunger of



Spindles Equipped with Individual Connections from the Main Air Line for Automatic Air Chucking

the valve mechanism and so releases the work, which either falls out or is removed by hand. The spindle remains stationary with the clutch open, for a sufficient length of time to allow loading a new piece into the chuck. The cams continue their action by releasing the valve plunger which causes the chuck jaws to close down firmly on the work. As soon as this occurs, the other set of cams moves the clutch spool forward, starting the spindle, and the machine indexes.

While the loading operations are going on in fourth position, the other three spindles are running, and their tools are working, so that no productive time is lost. As the operator will be located at the rear of this machine, the lever for engaging the feed is extended so that it may be operated from either front or rear. On setting up the machines, the air chucks can be operated in any position by a wrench on the squared ends of the valve stems beyond the pinion. This makes it possible to remove work for examination at any stage of machining.

In the mechanically operated chucking machine, the air cylinders are replaced by a special finger holder and cushioned reaction plate actuated by a second spool similar to that used in conjunction with the clutch. The finger holder is mounted upon the draw bar of the chuck behind the end of the spindle. In front of this, and screwed to the end of the spindle is the reaction plate which is a double disc made up of a hardened member against which the fingers bear, and a second disc which carries this upon springs. The finger holder and these two discs are tied together by bolts, the hardened member being free to slide upon these bolts between the other two members. A number of stiff springs in sockets in the member screwed to the spindle keep the hardened disc slightly separated from its mating member.

The spool which operates the chuck is actuated by cams on the rear drum of the machine and slides upon the spindle just in front of the cushioned reaction plate. When it slides to the rear, it spreads the fingers which extend through the slots in the reaction plate. As this takes place, the short arms of the fingers react upon the face of the hardened disc which up to a certain point ordinarily pulls the finger holder back, moving the draw bar with it and closing the chuck. When the piece to be chucked is irregular, the cushion springs will come into play, toward the end of the closing action of the fingers and will allow the hardened disc to depress slightly. This takes the place of the elasticity of the air and insures firm chucking without the possibility of crushing the work or straining the mechanism.

The draw bar is constantly pressed toward the spindle nose by a heavy coiled spring in a pocket in the rear end of the spindle which tends to open the chuck when the fingers collapse. This is not depended upon, however, but a positive opening is insured by a slide similar to that which opens the air chucks. This slide is actuated by a cam on the drum at the rear and carries an arm which presses down upon the end of the draw bar extending beyond the finger holder. Adjustment of the chuck jaws through their entire range is provided by nuts upon the rear end of the draw bar behind the finger holder. The largest chuck which this machine will swing is 6½ in. in outside diameter with a chucking capacity of 4½ in. In special cases, a tool slide feed of five inches is available.

Mounting and Demounting Wheel Press

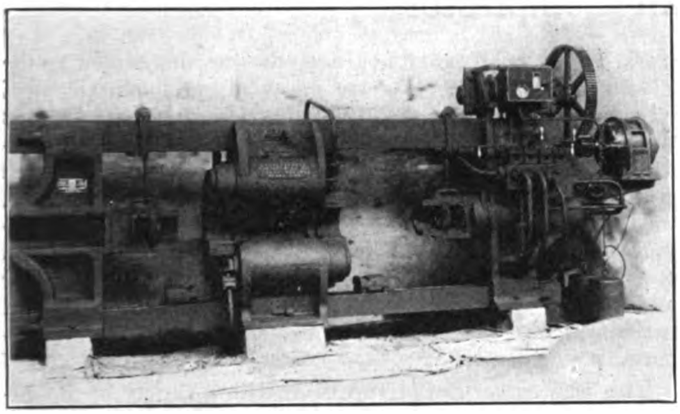
A MOUNTING and demounting wheel press adaptable to railroad car shops has been developed by the Chambersburg Engineering Company, Chambersburg, Pa. The predominating features of this press are its simplicity of design, ease of control, low cost of operation, few moving parts, stationary beams and the single motor drive.

The press is designed to handle car wheels and will force both wheels on or off an axle, simultaneously or one at a time. The press is automatic in its operation. It is especially designed for severe duty and to reduce maintenance and repairs to a minimum. The cylinder beams and the end resistance beam are open hearth steel castings and the cylinders are copper lined. The tension bars are steel forgings and the pump body and valves are made from solid steel.

All the beams are stationary and are provided with large bases, so that the press can be bolted direct to the concrete foundation. All the necessary adjustments for pressing on or off the wheels are made by small, light forcing blocks and sleeves suspended from a trolley. The cylinder beam at the right hand end contains the ram for pressing the wheels on their axles. The center beam is used for pressing wheels off their axles. This beam contains four rams, two for each right and left crosshead, the rams for each head being on a diagonal axis passing through the center of the press. The rams have a long bearing in the beam and are provided with safety valves so that when the plungers reach an outward stroke of 12 inches, the valves blow off, preventing over-travel. The resistance beam at the left hand end, which takes the thrust when forcing the wheels on or off

is provided with a removable steel facing head. It is recessed to permit long shafts to be readily handled in the machine.

Two independent pumps mounted in one body are attached to the right end beam. They are driven by a common eccentric shaft with a six throw eccentric. Each pump has two plungers ¾ inch in diameter and one plunger 1¾ inch in diameter by 6-inch stroke. The eccentric shaft and plungers run continuously from a motor mounted on the



Chambersburg Wheel Press Adaptable to Railroad Car Shops

press. When the conveniently located operating valves on the front of the press are open, the discharged water is by-passed to the supply tank. When either of these valves is closed, the discharged water is forced either to the right or left hand plungers of the center cylinder beam for demounting wheels. Stop valves in the pipe control the discharged water for the right cylinder beam and when these are set, the water is forced to this cylinders for mounting wheels. The large plungers of each side of the pump have a release valve so that when a pressure corresponding to about 100 tons on the rams is applied, these release valves open and by-pass water from the large plungers. The small plungers continue pumping until the maximum tonnage is reached, when a second set of release valves opens, preventing an excessive pressure. The valve trips are provided on the pump so that a variety of speeds can be obtained on the rams.

The rams are all made of close grained charcoal iron, turned and finished with a rolling process, thereby giving them a surface which resists the corroding action of water and keeps them smooth and polished. The inside end of the rams is provided with cup leather packing of improved design, arranged with a spring ring to prevent the collapse of the leather and loss of water when the ram is returning. Heavy counterweights are used for the pullback. They are connected to rams with wire ropes running over turned sheaves, thus assuring their rapid return. The right and left hand demounting crossheads, to which are attached the rams of the center cylinder beam, are open hearth steel castings and are provided with removable yokes.

Two assembly trucks on a track and a screw jack are furnished for use in loading and unloading the machine. They are equipped with grooved cups to suit 33-inch, 36-inch, and 38-inch wheels.

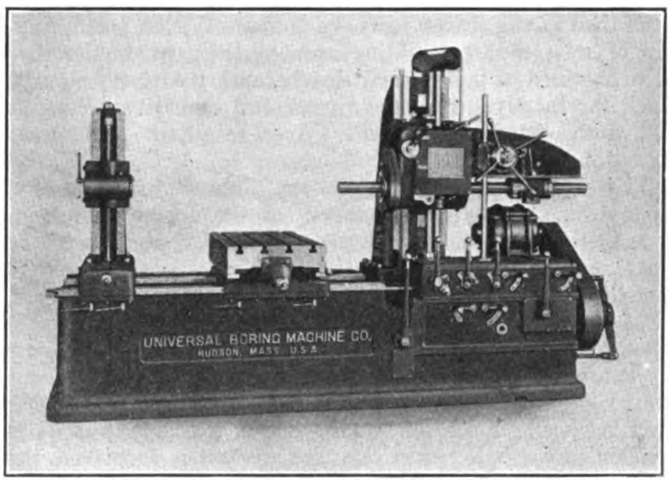
The presses are arranged for either belt or motor drive, as may be desired. When run by motor, a 20-hp. motor hunning at 900 r. p. m. is required for the 200-400-ton press; a 30-hp. motor running at about 900 r. p. m. is necessary to drive the 400-600-ton machine. In both cases if direct current is used, the motor must be compound wound. A guard completely covering the gearing is furnished with motor-driven machines.

Tri-Way Universal Horizontal Boring Machine

THE Universal Boring Machine Company, Hudson, Mass., introduced the first tri-way boring machine, which was fully described in the January, 1922, issue of the *Railway Mechanical Engineer*. It was designed with a 4½-in. boring bar, which restricted the spindle speed to 200 r.p.m. In order to overcome this restriction the same company has recently introduced a boring machine with a 2½-in. boring bar which gives a range of spindle speeds from 16 to 650 r.p.m. This provides for slow speeds for heavy milling and high speeds for light drilling.

The tri-way bed has three flat ways; the one in the front and the one in the center furnish guiding surfaces, and the one on the back supports the long carriage. It is rectangular in shape and is thoroughly ribbed and braced so as to prevent springing, even if it should happen to be placed on a poor foundation. A coolant system is provided and the top of the bed slopes to the head end, allowing the coolant to run down into the settling chamber at the end of the bed. From the settling chamber the coolant fluid overflows into another chamber, from which it can be pumped through suitable piping to the work. In addition to this, the new machine contains an oil pump in the head which is geared to the spindle and the drive shaft. This provides a spray of oil for all the gears in the head. The spindle gear box and the head is provided with a sight feed oil gage.

The head is similar to previous models, but is provided with a slow hand feed for the boring bar, and a lever for throwing in the high boring bar speeds. The boring bar reverse lever has been placed on the spindle box instead of on the head. The speed and feed gears are arranged in geometrical progression and located in two trays, the lower tray being filled with oil, and the gears in the upper tray being lubricated by splash and oil vapor. Both the speed and feed boxes are operated on the same principle. The levers for shifting speeds and feeds and for operating them are within easy reach of the operator's right hand. Automatic stops and rapid power traverse are provided in all directions. Located on the head column are two positive



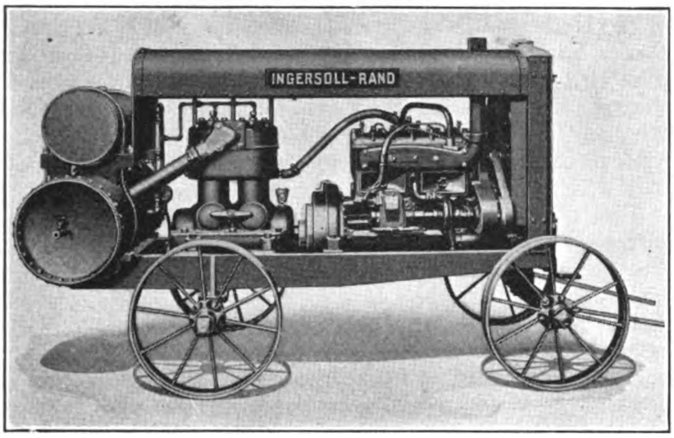
A 2½-In. Boring Machine with a Range of Spindle Speeds from 16 to 650 r. p. m.

stops which prevents the head from running out in either direction on the spindle shaft screw.

The bar reverse is equipped with a Carlyl-Johnson friction clutch. The machine is equipped throughout with S.K.F. ball bearings. A five-horsepower motor with a 25 per cent overload is recommended to drive the machine. Some of the standard specifications for this machine are as follows: The automatic travel of the main boring bar is 20 in. and the travel for resetting is 36 in. The overall size of the table is 20 in. by 42 in. The power crossfeed of the table is 32 in. The power longitudinal feed of the carriage is 24 in. The power vertical feed of the head is 20 in. There are 12 spindle speeds ranging from 16 to 650 r.p.m. The number of feeds in either direction is nine.

Ingersoll-Rand Air Compressor

A SMALL portable air compressor plant of modern design and construction, has been developed and is now being offered by the Ingersoll-Rand Company, New York. This small portable air compressor, designated as the $4\frac{1}{4}$-in. by 4-in. type "Twenty," has a piston displacement of 60 cubic feet per minute and is built along the same lines as the larger type "Twenty" portables. All of the proven features of the larger units are retained, e. g., duplex, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type gasoline engine; enclosed construction; circulating water cooling system for engine and compressor with sectionalized-radiator, fan and pump; compressor regulator and engine control for reducing speed during unloaded periods; one-piece cast steel frame; sheet steel roof and removable side doors.



Small Portable Air Compressor

This compressor can be furnished with a variety of mountings; steel wheels and axles; wooden artillery wheels with solid rubber tires and steel axles; on a Ford truck; and on skids for mounting in a car or truck. This and other sizes of type "Twenty" portable compressors are available with either gasoline engine or electric motor drive.

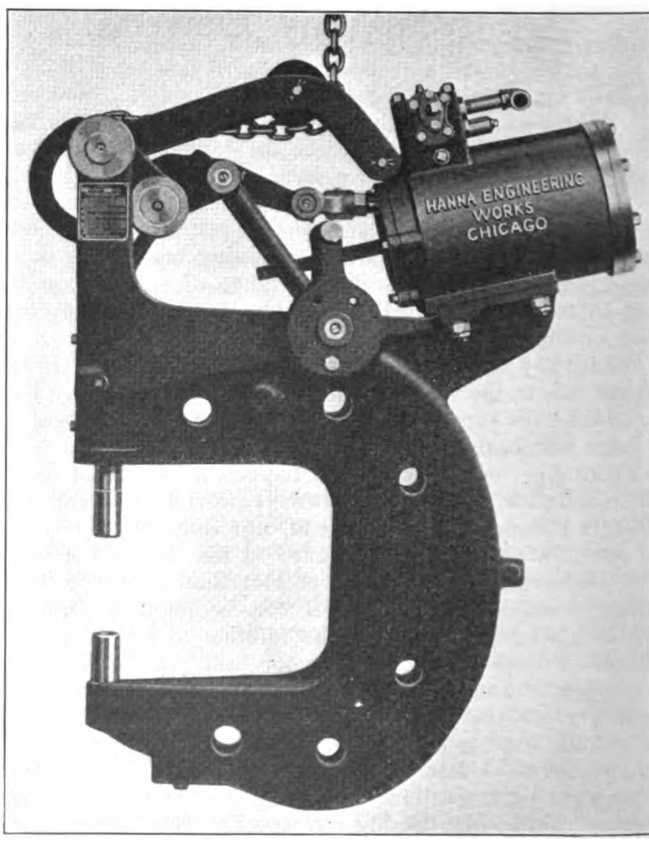
There are four larger Ingersoll-Rand portable compressors having the following piston displacements: 91, 160, 210 and 250 cubic feet free air per minute.

A Plunger Suspension for Riveting Machines

THE plunger suspension arrangement, shown in the illustration, has been developed by the Hanna Engineering Works, Chicago, Ill., as an accessory to its line of pneumatic riveters. Riveters equipped with this mechanism have been improved in their operating characteristics because of the fact that when the riveter is suspended in the position illustrated, the upper die is stationary and the lower die is movable. This permits the rivets to be stuck from the top and driven from the bottom. With a given number of men in an operating crew, greater production has been obtained with this machine because the rivets may be stuck far in advance of the riveter and each rivet demands less of the "sticker-in's" time. As a result, the continuous operation of the riveter is not interrupted.

The suspension is made from the plunger by means of a chain which passes over a sheave on the upper toggle pin. It is then passed under a sheave so placed at the top of the machine that the chain leading to the suspension hook is directly above the center of gravity of the riveter when the die screw axis is vertical. Operation of the mechanism to advance the plunger out of the frame barrel toward the lower die causes the entire frame being lifted. Since the plunger cannot go down, the lower die is forced to rise, thus driving the rivet head from below. This suspension rigging is independent of the bale suspension and when it is furnished, the riveter may be suspended by either method.

Incorporated in this riveter is a mechanism which develops a predetermined pressure uniformly throughout the last half of the piston stroke, or the last $\frac{1}{2}$ in. of rivet die travel, except on machines of over 80 tons, in which case it is the last 1 in. of die travel. This portion of the die stroke, which performs the critical setting of the rivet is, therefore, identical to the stroke characteristics of a hydraulic riveter. Further-



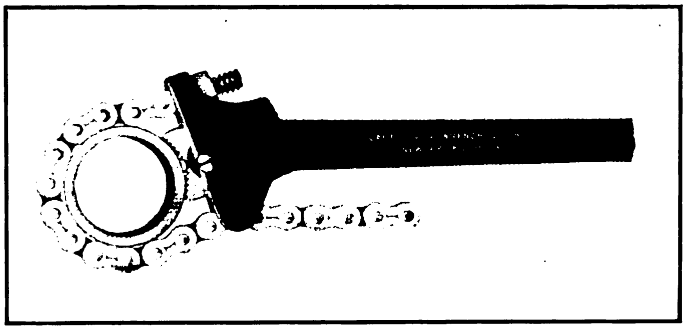
With This Suspension the Upper Die Is Stationary and the Lower Is Moveable

more, the early part of the die stroke, in which very little actual work is done on the rivet, is accomplished at an average leverage of 2 to 1, as compared to 12 to 1 for the uniform pressure portion of the stroke. Thus, the clearance gap between the dies is closed at a relatively small power consumption, while the heading of the rivet is performed under known conditions. This occurs without any adjustment of the die screw.

Reversible Chain Pipe Wrench

THE Cantilever Wrench Company, Newark, N. J., has recently placed on the market a chain pipe wrench which is especially well adapted to pipe work in shops or on locomotives where working space is restricted. The principal features of construction are simplicity, ease of replacement of parts and light weight. The reversible feature enables the user to put the chain on either side of the pipe and insures an easy ratchet motion which reduces to a minimum the chances for the chain to jam or for the wrench to slip. An adjusting nut is provided which can be used in tightening up the chain grip when working in very restricted spaces such as on coil pipe work. It can be used on any pipes that are far enough apart to slip the chain between them.

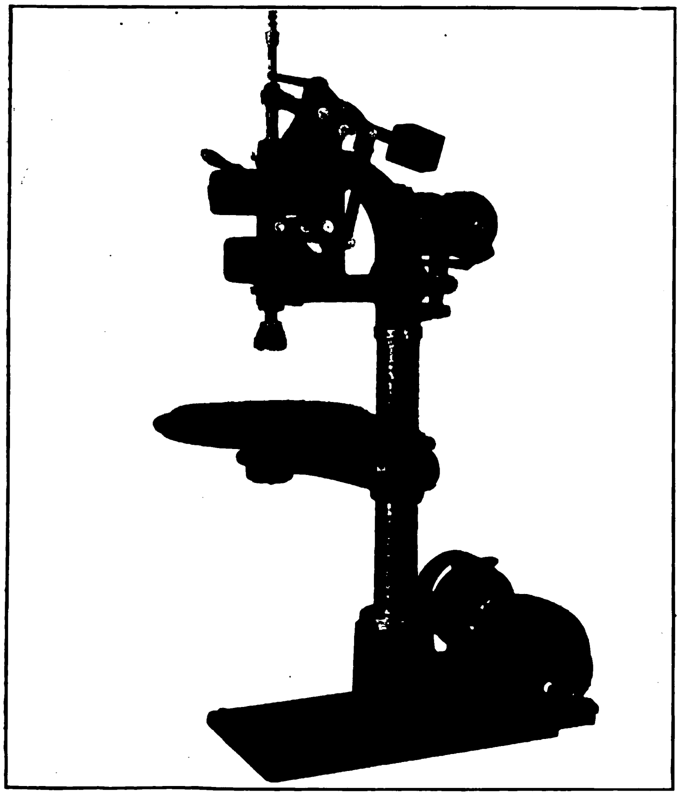
The design of this tool is such that it grips the pipe in any position. The direction of rotation can be reversed instantly without the necessity of removing the hands from the handle. This wrench is made in seven models suitable for use on pipe sizes from ½ in. to 12 in. and can be used not only as a pipe and fitting wrench, but also as a chain pipe vise.



The Chain and Jaws of This Pipe Wrench Grip Instantly in Any Position

Garvin Automatic Tapping Machine

THE Garvin Machine Company, New York, has redesigned its automatic tapping machine, the principal feature embodied in the new design being the addition of 12 Timken bearings which support the spindle pulleys, the idler pulley and the complete back shaft assembly section.



Important Rotating Parts Are Equipped with Timken Roller Bearings

The entire operation of this machine is controlled by a slight downward pull on the starting hand lever, after which the machine is entirely automatic. The spindle is fitted with two friction pulleys driven in opposite directions by one continuous belt. Between these pulleys is a double-faced friction clutch keyed to the spindle. This clutch is connected with the hand lever at the right, by a toggle mechanism which is quickly and easily adjustable to any desired tension.

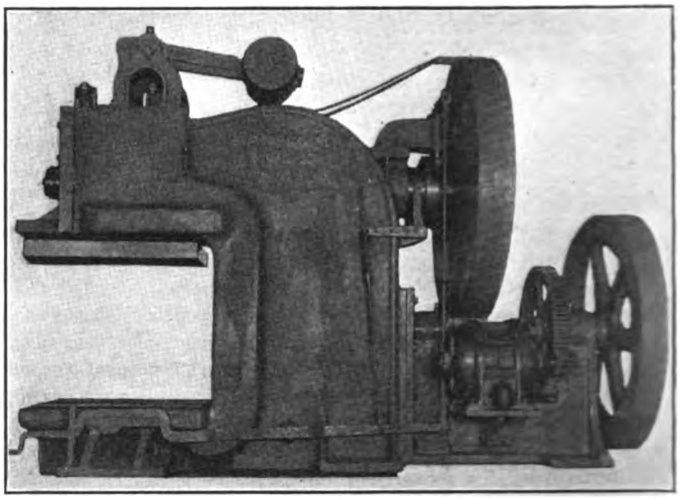
The previous driving pulley had an extended hub, which assembled into the head, and which revolved with the pulley. This hub formed not only the support for the pulley but also provided the bearing for the spindle. Thus both spindle and spindle bearing revolved and a tight belt could cause a cocked position, or cause excessive wear on the spindle box. To overcome this trouble the extended hub was done away with and it is now mounted on roller bearings. They are mounted on the stationary bronze spindle sleeve so that the pull is in direct line with the center of the bearing, and is in no way transmitted to the spindle. This construction gives additional support for the pulleys, eliminates the possibility of "cocking," and at the same time allows the long, stationary bronze sleeve to become the bearing for the spindle.

The table improvements include deep oil channels and a large drain into the oil reservoirs, eliminating the chance of disagreeable operating conditions due to oil clogging. The tee slots of the table are planed out of the solid for proper and ample clamping. The table is mounted on an arm that adjusts by rack, and locks in any desired up or down position, and it also swings around the column. The machine is simple to operate and contains various adjustments to safeguard against spoiling any work or damaging the machine to any extent.

Heavy Duty Single End Punching Machine

A HEAVY duty beam punch which is adapted to the perforating of steel plates and structural shapes that enter into car construction has recently been placed on the market by the Beatty Machine & Mfg. Company, Hammond, Ind. The principal feature of this machine is in the die space which must be large enough to assemble tools on it for production work. This permits the assembling on the machine in one setting of the necessary tools required to complete a piece of work, such as a center sill web plate, finishing all of the punching, coping and slotting in one pass through the machine.

The frame of the machine is of semi-steel; the bearings are of phosphor bronze with ring oilers; the gears are cut from solid steel. It is arranged for motor drive, all of the driving mechanism being mounted at the rear of the machine. The following are the general dimensions of the machine. The width of the ram from right to left is 34 in. and from front to back 42 in. The width of the table from right to left is 34 in. and from front to back 44 in. The stroke of the ram is 3 in. Its capacity is 240 tons.



Punching Machine Equipped with a Hand Operated Spacing Table

Gage for Determining the Wear on Diamonds

THERE has been a large increase in the use of diamonds for dressing grinding wheels in railroad shops during the past few years. As a rule they have been used according to the discretion of the individual operator, subject to some supervision by the foreman as to the proper length of time a diamond should be kept in service before resetting. It quite often occurs that a particularly hard diamond finds great favor with the operator, and consequently he frequently prefers to continue to keep the diamond in service for too great a time with the possible danger of imperiling the life of the diamond.

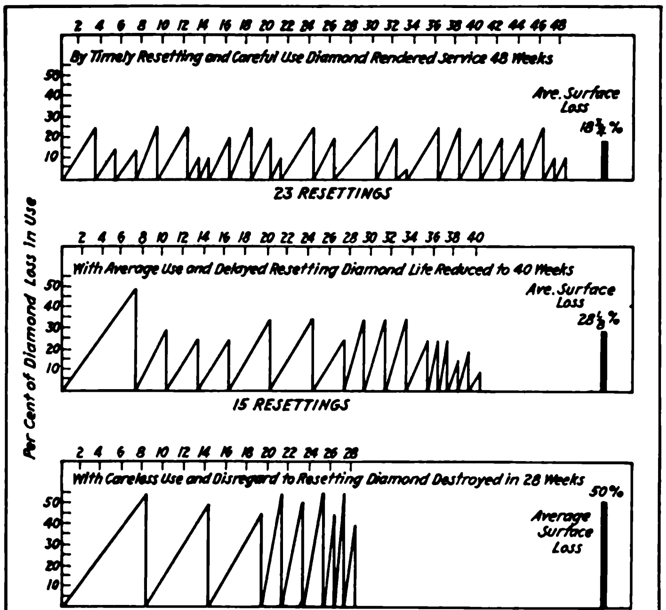


Fig. 1—Comparative Charts Showing the Average Life of Diamonds of the Same Quality and Size

It is generally recognized that the hard outer surface of a diamond gives the longest life, and by properly resetting the diamond it is possible to utilize the maximum outer surface. A diamond that has been worn to a very flat surface requires greater pressure to dress the wheel. As a result, a greater amount of heat is generated and the diamond is liable to break and disintegrate.

There is reproduced in Fig. 1 some comparative charts showing the average life of diamonds of the same quality and size. This chart is the result of records taken from tests made by the Joyce-Koebel Diamond Company, Inc., New York, on crankshaft grinding. The top chart shows the result of timely resetting and careful use of the diamond, which lasted over a period of forty-eight weeks. The middle chart is the result of average use and delayed resetting which reduced the life of the diamond to forty weeks. In this case the diamonds provided 16½ per cent less service. The bottom chart shows the result of giving a diamond only eight resettings, thus shortening the life to twenty-one weeks, or approximately 58 per cent of the service which could have been rendered.

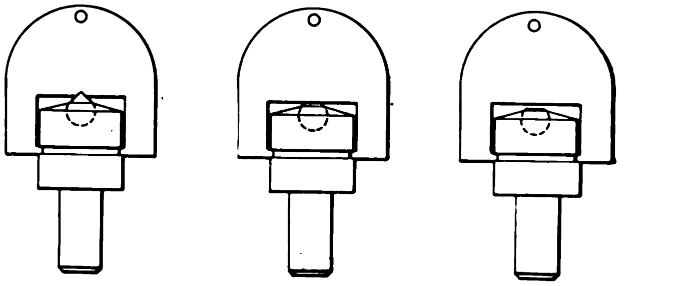


Fig. 2—These Drawings Show the Diamond Gage Placed on a Tool Provided with a New Diamond, a Tool Where the Diamond Is Ready for Resetting and Again Where the Diamond Has Been Worn Below the Safety Level

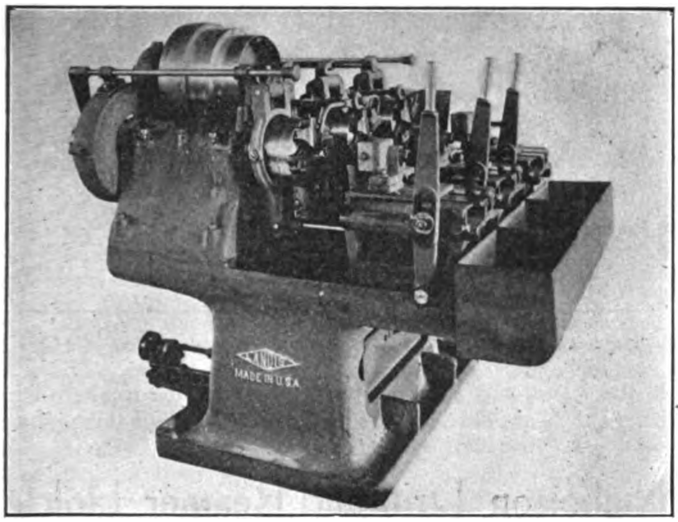
In order to overcome this difficulty a diamond gage, which is used in conjunction with a grooved diamond tool, has recently been designed by this company, patents for which are now pending. The drawings in Fig. 2 show the manner in which the new gage is applied to the grooved tool. The amount that a new diamond may be used with safety can be readily determined by the gage as shown in the center drawing. A diamond should never become worn below the

safety point, which is shown in the drawing on the right. The gage is standard, but the groove is varied and registers according to the size and shape of the diamond. Its application is such that the gage may be used without removing the diamond holder from the machine. It can be supplied for all types of diamond holders. Each time the diamond is reset a new holder is supplied, which is grooved to permit the diamond to be worn to a point of safety.

Landis Bolt Threading Machine

THE Landis Machine Company, Waynesboro, Pa., has placed on the market a new thread cutting machine. It is made in 1-in. and 1½-in. sizes in double and triple head types and in a 2-in. size in the double head type.

The spindles on the machine are located sufficiently close together to permit an operator to handle a three-head machine without shifting from one lever to another. They are independent and are controlled by the clutches located at the rear. The clutches are operated by bars extending over the die heads. Any one head may be stopped without shutting down the entire machine.

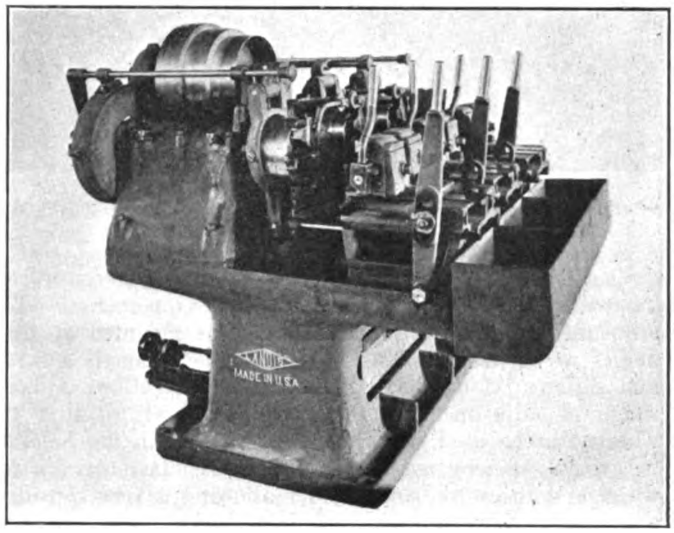


Landis Bolt Threader with Carriage Equipped with Vise Grips

The die heads are opened and closed automatically. The tripping rods which connect the carriage and the yoke of the die heads for opening and closing them, are provided with stop collars and are conveniently and quickly adjusted for various lengths of threads. All spindle gears have bronze bushings. The main bearings are capped and may be adjusted for any wear.

The carriage drive is in the center and comprises a rack and segment gear. These parts are thoroughly protected against dirt and chips. The levers operating the carriages are adjustable through a vee-toothed clutch which permits of a convenient position of the levers when cutting different lengths of thread. The levers may also be quickly changed from one side to the other side of the carriage.

The carriages on the machine are furnished with either bolt holders or vise grips. They are easily taken off and quickly applied. Both have horizontal as well as vertical adjustment so that the work may be in proper alinement at all times. The vise grips are lever operated which facilitate production. The grips, which are separate from the sliding jaws, are hardened and are quickly changed without disturbing any adjustments. The machines are furnished with boxes for holding the bolts. These boxes are placed on the front of the machine, where they will not interfere in any manner with the operator, and may be removed when threading long bolts. A geared oil pump supplies an abundant flow of lubricant to the die head. All moving parts are protected so as to eliminate any danger of an accident.



Bolt Threading Machine with Automatic Die Head Bolt Holders

Internal Grinder for Locomotive Cylinders

KNOWING the satisfactory results obtained from grinding applied to small cylinders, the Churchill Machine Tool Company, Ltd., Manchester, England, has designed an internal grinder to handle locomotive cylinders. This machine can be used for generating holes in exact relationship and at correct center distances from previously finished locating surfaces or slides, thus insuring alinement with the minimum of correction by hand work.

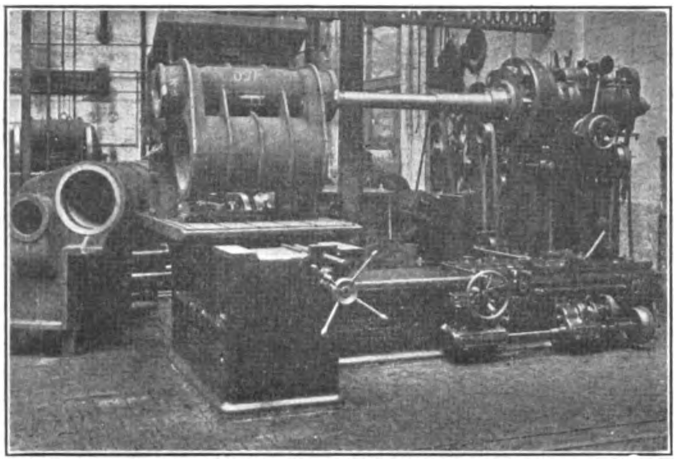
The machine is designed with a massive table with cross adjustment only for positioning the work, the table remaining stationary while the grinding is proceeding. It is carried on a base reaching directly to the floor, and, while coupled to the machine, is independent of it, so that it can be fitted to suit the exigencies demanded by various classes of work. If necessary the table can be removed and a base-plate substituted.

The grinding wheel spindles are provided with the necessary planetary motion, adjustable while grinding is proceeding, and are carried on a head which is vertically adjustable on a column. The column is mounted on a horizontal slide having an automatic longitudinal motion along the bed, controlled by adjustable reversing dogs for varying the stroke to suit the length of the hole to be ground. This slide is provided with various changes of speed for use while grinding, and on the No. 3 size machine there is an additional quick traverse, independent of the ordinary reversing dogs,

which can be brought automatically into action for traversing at high speed through the chambered portion of long holes.

The main spindle, on which is mounted the grinding wheel spindle, is also provided with various changes of speed, any of which can be brought into operation independent of the traverse speeds. The grinding wheel spindles are easily detachable from the main spindle, and can be changed in a few minutes for larger or smaller sizes. A full range of spindles is made.

The planetary motion to the grinding wheel spindles is



Churchill No. 3 Internal Grinder Truing the Valve Chamber of a Locomotive Cylinder

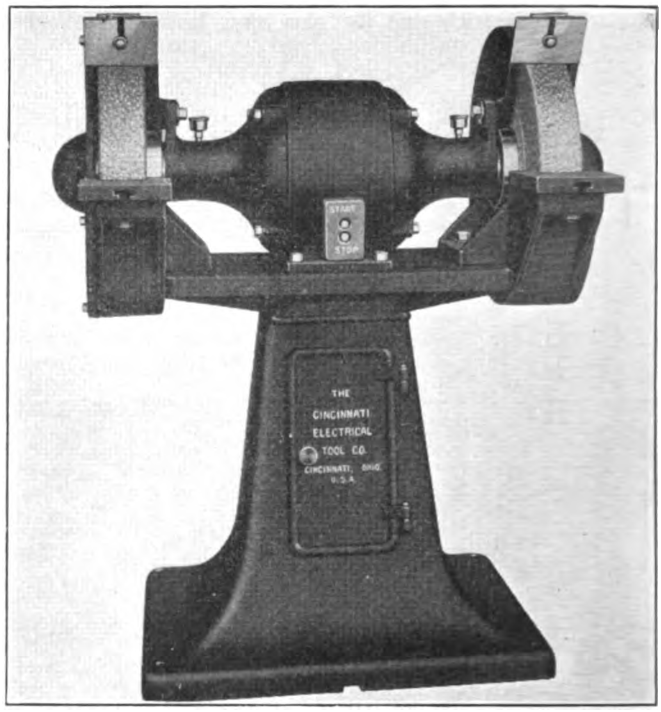
designed to permit especially sensitive control, the controlling hand wheels being provided with a dead stop motion. The adjustment is obtained direct on a slide mounted at right angles to the main spindle, and operated through a screw and differential motion. This construction allows a large range of adjustment to the grinding wheel, so that the wheels can be used considerably smaller than the holes to be ground, thereby reducing the arc of contact between the wheel and the work, and further allowing a very considerable range of wear to the grinding wheel.

By means of a cross adjustment of the table and the vertical adjustment of the spindle, articles having a number of holes can be ground without disturbing the setting of the work on the table. Within the capacity of the machine there is no limitation to the external shape of work which may be dealt with. The machines are self-contained in all their motions, being driven from a single overhead countershaft, or by a direct coupled constant speed motor.

Heavy Duty Floor Grinder

THE Cincinnati Electrical Tool Company, of Cincinnati, Ohio, has recently added to its line of portable electric drills, grinder and buffers a 5-hp. heavy duty floor grinder, suitable for heavy grinding of all kinds in railroad shops. The motor is equipped with fully enclosed ball bearings, which prevent emery dust and dirt from getting into the bearings and windings, thereby increasing the life and efficiency of the machine. The ball bearings are correctly locked to the shaft to provide end thrust and also to eliminate wear and friction. This grinder will carry wheels up to 18 in. in diameter by 3 in. face. The wheel guards are of the exhaust type, complying with all safety standards, and are adjustable for wear of the wheels. Removable covers bolted to the guards completely enclose the sides of the wheels, flanges and nuts, ensuring safety to the operator.

The starting switch is of the magnetic type, push-button control and is mounted on a separate panel within the column. It is readily accessible and insures ample protection

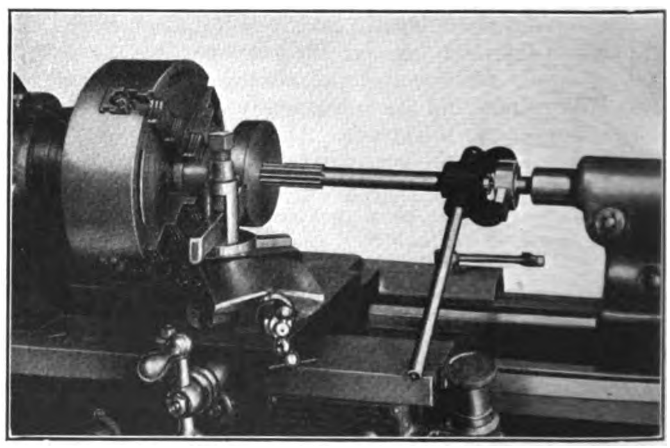


Cincinnati Electrical Two-Wheel Motor Driven Floor Grinder

to the operator. This machine may be had for alternating current 220 or 440 volts, 25 to 60 cycles, two or three phase.

Nicholson Drill and Reamer Holder

W. H. NICHOLSON & COMPANY, Wilkes-Barre, Pa., has recently put on the market a drill and reamer holder which can be used either on a lathe or a drill press. When using it on a lathe, the holder takes the place of the live center and acts as a dog, driver and hold-back. It can also be used in a turret lathe and screw machine, where



Nicholson Reamer Holder Applied to a Lathe

it acts as a floating holder. In this capacity it eliminates the adjusting of bolts or screws and also the changing of bushings. When used on a drill press where it furnishes a strong, positive drive. Hardened steel plates are used to line up the drills and the center holds them in alinement, reducing bell-mouthed holes to a minimum. These holders are furnished in any taper or straight shank required up to $1\frac{1}{2}$ in. in diameter.

GENERAL NEWS

The car repair shops of the Baltimore & Ohio at Sandusky, Ohio, were reopened on August 18 after being closed since January 26.

The shops of the Delaware & Hudson at Colonie, N. Y., report that from April 21 to August 4 the 1,000 employees in the shops worked 1,000,000 hours without a man being hurt.

Shopmen employed in the main shops of the Canadian National at Montreal, Que., and Stratford, Ontario, have voted in favor of closing down one week in each month rather than to have a number of the men laid off altogether. The other shops of the Central region, in which region the vote was taken, decided against the plan of closing down one week each month, preferring the layoff system. The decision of the men has been accepted by the management.

46.8 Per Cent of Locomotives Found Defective

Of 5,460 locomotives inspected by the Bureau of Locomotive Inspection during July, 2,553 or 46.8 per cent were found defective and 282 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of equipment. During the first six months of 1924, of 34,174 locomotives inspected, 17,482 or 51 per cent were found defective and 2,842 were ordered out of service. Of 95,047 freight cars inspected by the Bureau of Safety during July, 3,692 or 3.9 per cent were found defective and of 2,162 passenger cars 25 were found defective. During the month 40 cases, involving 123 violations of the Safety Appliance Acts, were transmitted to various United States attorneys for prosecution.

New Locomotive Repair Shops for Southern

This company has awarded a contract to the Foundation Company for the design and construction of new locomotive repair shops at Atlanta, Ga. The main building will be a double transverse erecting and machine shop for locomotives, about 325 ft. long and over 300 ft. wide. It will be of steel construction with brick walls, and will provide facilities for two 200-ton electric traveling cranes and several smaller cranes, some of which will be located inside the building and others in the yard. The new shops will require additional boiler capacity in the power plant, which work is included in the contract. Designs are being prepared by the Foundation Company collaborating with the railroad company's engineers. Construction will be started in about three weeks. It is estimated that it will take six months to finish the contract, and the total cost will be over $750,000.

N. Y. C. Veterans' Summer Home

The New York Central Veterans' Association has bought a camp at Lake Placid, N. Y., consisting of 35 acres of land and 14 buildings and is putting the buildings and facilities in order for use the present summer, as a vacation resort for the members of the association. Lake Placid is in the Adirondack Mountains about 125 miles north of Utica, and is a noted resort in winter as well as in summer. The buildings and improvements on the grounds represent a cost of $125,000, but the whole establishment has been bought at an attractive price.

The privileges of the camp are primarily for members of the Veterans' Association but other employees of the railroad will probably be admitted at a small advance in the rates over those charged to members, the purpose being to make the fullest possible use of the facilities. The nine principal buildings, after some slight alterations, will accommodate 125 guests. The Veterans' Association now numbers about 1,000 members. The president is William O. Wichman, locomotive engineman; secretary, J. M. Wooldridge, a chief clerk in the legal department, New York City. Employees of the road are eligible to membership after 20 years' service, 15 years of which must have been continuous.

Locomotive Inspector Indicted for Perjury

Robert Addison, a locomotive inspector of the Boston & Maine, was indicted in the Federal Court at Albany, N. Y., last May for perjury, in the signing of a report which he had made in January last, wherein he declared that the tubes in locomotive No. 3009 were in good condition. Upon investigation by the Interstate Commerce Comimssion of the blowing out of one of the boiler tubes while this engine was passing through Hoosac Tunnel, on February 14, when scalding water was discharged into the cab, scalding the engineman and fireman, it appeared that Addison had in regular form certified that the tubes of this engine were in good condition when, in fact, the center arch tube did not extend through the throat sheet sufficiently to permit it to be belled or headed. The government contends that Addison had himself installed this particular tube and was aware that it was not in safe condition.

Attorney General Stone announces that he intends to urge a speedy trial of this case, deeming it the duty of the Department of Justice to give vigorous support to the Interstate Commerce Commission in its work of promoting the safety of locomotive operation.

Attorney General Stone in his statement refers to the need of additional inspectors for the 76,000 locomotives in the country, a need which has been pointed out by the Interstate Commerce Commission in its annual reports. The penalty for violation of the locomotive inspection law is comparatively small, whereas perjury, if proved in court, may be punished more severely.

It is expected that Addison will be tried at Auburn, N. Y., on October 7 next.

The Department of Justice is said to be in favor of amending the law so as to provide that when railroad inspectors overlook patent defects, they can be adjudged guilty of criminal negligence and the railroad officers held jointly responsible for the negligence of employees.

Program of German Railway Congress

The railway technical congress to be held in Berlin on September 22-27, under the auspices of the Society of German Engineers and the German State Railways will consider, among other things, the following subjects:

Freight transportation, with reference to heavy cars, rapid unloading and the relationship of these cars to bridges and tunnels.

Locomotive progress—thermal efficiency, steam condensation, turbine and Diesel locomotives, screw-shaped flues, pulverized coal, iron flues, economy of internal combustion locomotives.

Electrification and signaling.

Shop practice.

Passenger and transfer stations, operating questions, subaqueous tunnels, switching.

The exhibits in connection with the congress will be most extensive. More than 100 various types of locomotives and motor cars will be on view, including over 50 different types of steam locomotives, 10 electric locomotives, 6 Diesel locomotives, sundry compressed air, fireless and internal combustion engines and a turbo-locomotive. All kinds of freight and passenger cars will also be on exhibit. There will be a special demonstration of yard operation and various diagrams, films, and models will be available through the co-operation of the Berlin-Charlottenburg Technical Institute. One day will be devoted to brake tests on a 90-axle passenger train.

F. K. Loeffler, president of the Techno-Service Corporation, 46 West Fortieth street, New York, whose company is the American agent of the Borsig Company, the German locomotive

builders, has volunteered to give whatever further information is desired to persons from the United States or Canada, who may be interested in attending the congress.

Union Officers to Serve Prison Term

Five officers of the Federated Shop Crafts, who were found guilty by the United States District Court at El Paso, Tex., of a charge of conspiracy to interfere with interstate commerce during the shopmen's strike in 1922, must serve their prison sentences and pay their fines, according to a decision by the United States Supreme Court upholding the District Court. The men, who were convicted of putting quicksilver in Southern Pacific locomotives at El Paso and San Antonio, were each sentenced to 10 months in prison and to pay a fine of $2,500. In spite of the efforts of a large array of defense attorneys, the men were convicted before United States Judge Smith at El Paso in January, 1923. Subsequent appeals to the United States Court of Appeals at New Orleans and to the Supreme Court resulted in affirmations of the decree of the District Court.

Great Northern Holds Stores Convention

What is believed to be the first system convention of store officers on an American railroad was held at Great Falls, Mont., on July 23 and 24 by the Great Northern Stores Association as the first of a series of meetings which it is proposed to hold annually from now on. The meeting, which was conducted under the direction of Robert Steel, district storekeeper, Great Falls, included addresses by Howard Hayes, general storekeeper of the system, and president of the Association, O. H. Wood, assistant purchasing agent, and I. Parker Veazy, Great Northern attorney for Montana.

Other business included a report on the meeting of the Purchases and Stores section of the American Railway Association at Atlantic City by C. E. Talmadge, assistant general storekeeper; motion pictures of supply train operation over the Northern Pacific and of shop delivery practices on the Southern Pacific; together with the presentation and discussion of reports and papers prepared by members on the following subjects: Stores Department Accounting, Specifications for Trays and Shelving, Material Classification, Facilities for Handling Material, Supply Car Operation; Delivery of Material to Shops, Yards, and Repair Tracks; and Storekeeping Methods for Forest Products.

The association, which is newly organized, has for its object the improvement of methods and practices used in the ordering, handling, storage, and distribution of materials and the accounting in connection therewith. Its membership is composed of active and associate members, local storekeepers, division and district storekeepers and their assistants, chief clerks and general foremen at general and district stores, together with the general storekeeper and his assistants, constitute the active members while associate members include such other employees in the purchases and stores organization as are admitted to the organization by action of a general committee. Provision is also made for honorary members.

The general storekeeper and the assistant general storekeepers are ex-officio president and vice-presidents, respectively, of the association, while the management of the activities is conducted by a general committee consisting of three members selected by the association annually at its regular meeting from among members proposed by a nominating committee which is also elected at each anual meeting. The General Committee makes the necessary arrangement for the meetings of the association, conducts the general meetings, selects and appoints the members of all standing and special committees, and examines all the communications, papers and reports intended for presentation to the association deciding which of them or what portions of them shall be presented. A. L. Nelson, district storekeeper at Hillyard, Wash., was elected chairman of the general committee for the ensuing year.

MEETINGS AND CONVENTIONS

Third Machine Tool and Engineering Exhibition

Particular interest will attach to the exhibition of machine tools and accessories to be held at the Olympia, London, England, September 5 to 27, on account of the fact that the British Empire Exhibition and other events have attracted thousands of visitors from all parts of the world to London. This exhibition is the third of its kind organized by the Machine Tool Trades Association, and in view of the fact that three or four years will elapse before it is repeated, it is expected that engineers from all parts will attend. The machine tool exhibition, in conjunction with the Palace of Engineering at Wembley, will provide an excellent opportunity for engineers to acquaint themselves with the quality of British engineering productions.

Lord Askwith, K. B. E., K. C., will have charge of the opening ceremony on Friday, September 5. The exhibition will be open to the public so that those present will be able to witness the formal opening. The luncheon following the ceremony will be attended by the members of engineering institutions throughout the country. The whole of the machinery, which is representative of all British machine tool interests, will be running during the exhibition.

LOCOMOTIVE REPAIR SITUATION—FORMER METHOD OF COMPILATION

Date, 1923	No. locomotives on line	No. serviceable	No. stored serviceable	No. held for repairs req. over 24 hours	Per cent	No. held for repairs req. less 24 hours	Per cent	Total held for repairs	Per cent
January 1	64,453	48,905	576	13,587	21.1	1,962	3.0	15,549	24.1
April 1	64,559	50,107	914	12,801	19.8	1,651	2.6	14,452	22.4
July 1	63,906	52,456	2,181	10,326	16.2	1,124	1.8	11,450	18.0
October 1	63,982	54,159	2,620	8,789	13.7	1,034	1.6	9,823	15.3
1924									
January 1	64,406	54,031	5,061	9,395	14.6	980	1.5	10,375	16.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
May 1	64,330	52,890	6,079	6,105	9.5	5,335	8.3	11,440	17.8
June 1	64,373	53,498	6,661	6,099	9.5	4,776	7.4	10,875	16.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
August 1	64,486	53,381	7,152	6,073	9.4	5,032	7.8	11,105	17.2

FREIGHT CAR REPAIR SITUATION

Date, 1923	Number freight cars on line	Cars awaiting repairs			Per cent of cars awaiting repairs	Month	Cars repaired		
		Heavy	Light	Total			Heavy	Light	Total
January 1	2,264,593	164,041	51,970	216,011	9.5				
April 1	2,296,997	154,302	52,010	206,312	9.0				
July 1	2,260,532	146,299	44,112	190,411	8.4	June	121,077	2,451,758	2,572,835
October 1	2,270,840	118,563	32,769	151,332	6.7	September	114,064	2,335,161	2,449,225
November 1	2,263,099	116,084	34,540	150,624	6.6	October	117,254	2,444,118	2,561,372
December 1	2,270,405	116,697	38,929	155,626	6.8	November	104,761	2,214,617	2,319,378
1924									
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
February 1	2,269,230	115,831	45,738	161,569	7.1	January	76,704	2,083,583	2,160,287
March 1	2,262,254	119,505	49,277	168,782	7.5	February	70,056	2,134,781	2,204,837
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
May 1	2,271,638	131,609	47,666	179,275	7.9	April	75,352	2,074,629	2,149,981
June 1	2,280,295	138,536	50,683	189,219	8.3	May	73,646	2,130,284	2,203,930
July 1	2,279,826	144,912	49,957	194,869	8.5	June	70,480	1,888,899	1,959,379
August 1	2,278,773	153,725	49,139	202,864	8.9	July	72,347	1,567,430	1,639,777

General Foremen's Association Convention

The topics to be discussed at the convention of the International Railway General Foremen's Association, which will be held at the Hotel Sherman, Chicago, September 9 to 12, inclusive, are as follows: (1) Steel Car Repair Facilities and Methods of Repairs to Various Parts of All Classes of Steel Cars; (2) Labor Saving Devices Other Than Those Sold or Patented (Shop Organization from General Foreman Down); (3) Terminal Inspection, Running Repair Costs and Repair Work Practices; (4) Maintenance of Superheaters; Feed Water Heaters; Locomotive Stokers and the Locomotive Booster.

Safety Congress in Louisville

The Thirteenth Annual Safety Congress of the National Safety Council will be held in Louisville, Ky., from September 29 to October 3.

The program of the Steam Railroad Section is as follows:

September 30

1. Better Management Through Co-operation, by Henry Bruère, Third Vice-President, Metropolitan Life Insurance Company.
2. Report of Officers.
3. Development of Safety on the Railroads, by Charles Frederick Carter, New York Central.
4. Reports of Committees.
5. Safety and Fire Prevention.

October 1

Election of Officers.

Safety from the Standpoint of:

1. The Transportation Department, by E. G. Neumann, Union Pacific.
2. The Car Department, by W. A. Clark, General Car Foreman, Duluth, Missabe & Northern.
3. The Track Department.
4. The Locomotive Engineer, by D. J. Buckley, Locomotive Engineer, Baltimore & Ohio.
5. The Shopman.
6. The Conductor.
7. The Trainman, by F. G. Kileen, General Chairman, Wabash, Brotherhood of Railroad Trainmen.

Safety Inspectors' Session—October 2

1. Presentation of Inspector's Problems, by J. A. McNally, Safety Inspector, Wabash.
2. Organizing and Maintaining Interest Among Committeemen, by H. Corbin, Supervisor of Safety, Atlantic Coast Line.
3. Acquiring a Safety Conscience, by W. L. Allison, Baltimore & Ohio.
4. Getting Co-operation of Local Safety Committeemen, Local Officers and Labor Representatives, by D. E. Satterfield, Safety Inspector, Chesapeake & Ohio.
5. Interesting the Individual in Safety Work, by J. A. Clancy, Safety Representative, New York, New Haven & Hartford.
6. General Discussion.

Car Inspectors' and Car Foremen's Association Convention

The following program has been arranged for the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, which will be held at the Hotel Sherman, Chicago, September 23, 24 and 25:

September 23

10:00 a. m.
- Invocation.
- Address by president.
- Address by R. H. Aishton.
- Report of Entertainment Committee.
- Report of secretary and treasurer.
- Address—Freight Claim Prevention, by Joe Marshall, special representative, American Railway Association.
- Discussion.

2:00 p. m.
- Efficiency and Heavy Car Repair Shop Operation, by H. W. Williams, special representative to general superintendent motive power, C. M. & St. P.
- Treatment of Journal Lubrication, by H. O. Drody, service engineer, Galena Oil Company.
- Automobile Loading in Closed and Open Cars, by P. Alquist, master car builder, Pere Marquette.
- Discussion.

September 24

9:30 a. m.
- Steel Car Repairs, by J. A. Roberts, Chief A. R. A. clerk, Chesapeake & Ohio.
- A. R. A. Billing, by B. F. Jamison, special traveling auditor, Southern railway.
- Discussion.

2:00 p. m.
- Question Box Committee report and discussion of Billing Rules.

September 25

9:30 a. m.
- Extension—Question Box Committee.
- Discussion of A. R. A. Rules of Interchange.

2:00 p. m.
- Election of officers.
- General discussion.
- Adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention September 3, 4 and 5, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting September 8, 8:00 p. m. The meeting will be addressed by E. Von Bergen, air brake and lubricating engineer, Illinois Central, who will talk on the subject of hot boxes.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y. Next meeting September 11. A paper on Smooth Handling of Trains, covering both passenger and freight trains, will be presented by E. R. Boa, road foreman of engines, New York Central.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting September 9. Dinner and addresses.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12, Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Next meeting September 19, 8 p. m. James Paterson, managing director, Carter-Paterson, Ltd., London, England, will read a paper on Store Door Delivery and British Motor Shipping Methods. W. L. Bean, assistant mechanical manager, New York, New Haven & Hartford, will discuss the Rail Motor Car.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting September 12. A paper on The Railroads of Manchuria will be read by B. B. Milner, mechanical engineer, Missouri-Kansas-Texas, Parsons, Kans. Moving picture film South Manchurian railways.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 16, 17, 18 and 19.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

D. M. French, mechanical engineer of the Gill Railway Supply Company, with headquarters at Peoria, Ill., has been transferred to Chicago.

The Consolidated Machine Tool Corporation of America has removed its Colburn Machine Tool Works from Cleveland, Ohio, to its Betts Machine Works, Rochester, N. Y.

F. A. Keihn, formerly of the engineering department of the International Motor Company, has been appointed sales engineer, automotive car division, of the J. G. Brill Company.

The Shelton Adjustable Double Deck Car Company has opened offices at 1019 Monadnock building, San Francisco, Cal., and will manufacture and sell an adjustable deck for freight cars.

Theodore B. Counselman has been appointed western representative of the Clark Car Company, Pittsburgh, Pa. Mr. Counselman has his headquarters at 122 South Michigan avenue, Chicago.

The Hanna Engineering Works, 1765 Elston avenue, Chicago, is now represented in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island by the Eggleston Supply Company, 259 Franklin street, Boston, Mass.

R. L. Mead, engineer and salesman for the Brown Hoisting Machine Company, has been appointed western sales manager of the Ohio Locomotive Crane Company, with headquarters in the Railway Exchange building, Chicago.

The Fairmont Railway Motors, Inc., has opened a Pacific coast branch office at 637 Mission street, San Francisco, Calif. R. W. Jamison has been appointed district sales manager for the states of California, Washington, Oregon and Nevada.

David E. Drake, of the sales department of the Westinghouse Electric & Manufacturing Company, has retired at the age of 76 after a career of 50 years in the electrical industry, 34 of which were spent in the service of the Westinghouse Company.

The American Locomotive Company has awarded a contract to the Chicago Bridge & Iron Works for the furnishing and erecting of a 50,000-gal. tank on a 100 ft. tower at its Richmond, Va., plant. The tank will be used for the purpose of affording fire protection.

L. G. Coleman, assistant general manager of the Boston & Maine, has resigned to become manager of the locomotive department of the Ingersoll-Rand Company, New York, which has been organized to handle the oil electric locomotive. W. L. Garrison has been appointed assistant manager of the same department.

The Celotex Company, of Chicago, has closed a contract with the American Refrigerator Transit Company for the insulation of nearly 2,000 refrigerator cars with Celotex. It will require 3,500,000 ft. of Celotex to fill the order. Celotex is an artificial lumber product made from cane fibre and is lighter than ordinary insulating material.

Fred A. Meckert, formerly general manager of the Fort Pitt Spring & Manufacturing Co., and since last April president of the Mitchell Spring & Manufacturing Co., Johnstown, Pa., resigned on August 1, on account of ill health and is now in San Francisco, Cal. Mr. Meckert on his recovery expects to re-enter the same line of business.

F. E. Mills, general credit manager of the Wayne Tank & Pump Company, with headquarters at Ft. Wayne, Ind., has been appointed assistant treasurer, with the same headquarters. C. L. McDavitt, former European financial manager, with headquarters at Paris, France, has been appointed office manager, with headquarters at Ft. Wayne, Ind.

The Buffalo, N. Y., office of the Cutler-Hammer Mfg. Co., in the Ellicott Square building, which was formerly a part of the eastern district, has been made a part of the central district, of which A. G. Pierce is general district manager, with headquarters at Pittsburgh. The central district includes the territories covered by the Buffalo, Pittsburgh, Cleveland and Cincinnati offices. B. A. Hansen is manager of the Buffalo office.

H. M. Richards has been appointed district manager of the American Rolling Mill Company, Middletown, Ohio, in charge of its Cleveland district office at 1408 B. F. Keith building. For a number of years Mr. Richards was located at the home offices, and in recent years, at the Pittsburgh district office. J. T. Hagan, of Cleveland, is associated with Mr. Richards in his new work.

The Gibb Instrument Company, Bay City, Mich., has appointed F. J. DeLima as agent for the sale of its line of electric welding and electric heating machines in the Dominion of Canada. Mr. DeLima's headquarters are in the Keefer building, Montreal. D. A. Clements has been appointed representative of the Gibb Instrument Company in Missouri and southern Illinois, with headquarters at 4167 Washington avenue, St. Louis, Mo.

T. H. King, for the past twelve years sales manager of the Landis Tool Company, has resigned to become treasurer and general manager of the Wayne Tool Manufacturing Company, Waynesboro, Pa. Mr. King, who received his early training in tool manufacturing in the employ of the L. S. Starrett Company, Athol, Mass., and was later employed by the B. F. Sturtevant Company, Boston, Mass., had been actively connected with the Landis Tool Company for the past eighteen years.

Edmund F. Boyle, Pacific coast representative of a number of railway supply companies, with office in San Francisco, Cal., died on July 14, in Los Angeles, Cal. Mr. Boyle went to San Francisco about four years ago as the representative of the following concerns in the Pacific coast territory: Ashton Valve Company; Pilot Packing Company; Locomotive Firebox Company; Nathan Manufacturing Company; Premier Staybolt Company; Grip Nut Company; Magnus Company, Inc.; Heywood-Wakefield Company; Bradford Corporation; Union Metal Railway Equipment Company; Standard Railway Equipment Company; Cincinnati Rivet Cutting Gun Company and the Oxweld Service Company. Mr. Boyle was born on January 5, 1875, and entered the service of the Chicago & North Western in 1889 as water boy and was subsequently in the service of the bridge and building department of that road until 1890. In 1891 he entered the service of the Chicago, St. Paul, Minneapolis, & Omaha and shortly thereafter became a fireman. He then served as engine dispatcher and in 1895 was promoted to engineman. In 1899 he entered the service of the Galveston, Harrisburg & San Antonio in the same capacity and was appointed assistant superintendent in 1913. He was appointed general road foreman in 1914 and entered the service of the Southern Pacific as an engineman shortly thereafter, from which position he resigned in 1920 to enter the railway supply field.

E. F. Boyle

Harold B. Jones, president of the Mid-West Forging Company, with headquarters at Chicago, and a former vice-president of the Inland Steel Company, died on July 18, following a four-day illness of pneumonia. He was in the employ of the Inland Steel Company for 15 years and during the latter two years of his connection with this company he supervised the operation of the company's plant at Chicago Heights. He resigned from the Inland Steel Company in 1923, to become president of the Mid-West Forging Company.

The Victor Tool Company, Waynesboro, Pa., manufacturers of collapsible taps, automatic die heads, floating toolholders, and nut facing machines, has been merged with the Landis Machine Company, Waynesboro, Pa. In the future all correspondence applying to Victor products should be addressed to the Landis Machine Company, Victor plant, Waynesboro. The trade name "Victor" will continue to be applied to the tools formerly made by the Victor Tool Company, and there will be no change in the selling arrangements of these products. This merger permits the Landis

Machine Company to handle both internal and external threading requirements.

Fred P. Pfahler, district master mechanic of the Baltimore & Ohio, with headquarters at Pittsburgh, Pa., has resigned to become associated with the professional staff of the Roberts-Pettijohn-Wood Corporation, engineers and accountants, Chicago. He will devote his entire time to professional work in connection with the introduction of modern methods and improved practices in railway shop management and operation, and as a consultant in railway mechanical engineering work. Mr. Pfahler has spent more than 30 years in railway mechanical engineering work, principally in the employ of the Wheeling & Lake Erie and the Baltimore & Ohio. For four years he was with the Interstate Commerce Commission's Locomotive Inspection Bureau as an inspector. During the period of federal control he served as chief mechanical engineer and as a member of the Committee on Standards of the Central Organization of the United States Railroad Administration. At the conclusion of federal control he returned to the Baltimore & Ohio as district master mechanic.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has made a number of changes in its sales organization, dividing the company's products into two general classes, engineering and merchandising. T. D. Montgomery, formerly manager of the eastern district, with headquarters at New York, has been appointed assistant sales manager in charge of engineering sales. He is now located at the main office in Milwaukee. A. H. Fleet, formerly manager of the specialty department at Milwaukee, now has charge of the sale of all merchandising products of the company. C. W. Yerger, formerly manager of the Boston office, is now manager of the eastern district, assuming the former duties of Mr. Montgomery. J. M. Fernald succeeds Mr. Yerger as manager of the Boston office. A Milwaukee branch sales office has been opened in charge of J. U. Heuser, formerly of the Chicago office of the company. This Milwaukee branch office is part of the district including Detroit, St. Louis and Chicago, the latter being the main office, of which H. L. Dawson is manager.

The acquisition of additional plants by the Link Belt Company, Chicago, and the extension of its lines and business during the past five years have necessitated changes in the organization. The chairman of the board was made the chief executive officer of the company and an executive committee of four was created to act in an advisory capacity to the officers. Charles Piez, president, was elected chairman of the board and chairman of the executive committee. Alfred Kaufmann, second vice-president, was elected president and will have the general direction and supervision of operations and sales. Staunton B. Peck, retains the position of senior vice-president and directs and supervises operation and sales of the eastern district. A. C. Johnston, formerly in charge of the operations and sales of the Chicago and western district, has been promoted to second-vice-president in charge of operations and sales in the western district. Humphrey J. Kiely, who has had charge of the company's foreign business, as well as the domestic business centering in the New York district, has been elected third vice-president and continues in charge of exports and sales in the New York district. Mr. Kaufmann has been with the Link Belt Company for 24 years beginning in the engineering department and moving successively to the construction department, the general office as assistant to the president, the managership of the Philadelphia plant and to the position of vice-president in charge of the company's Indianapolis operations. For the present, Mr. Kaufmann's headquarters will be at Indianapolis, Ind.

National Railway Appliances Association to Have More Space

The National Railway Appliances Association has arranged with the Coliseum Company, Chicago, for additional space 105 ft. by 172 ft. in area immediately north of the present building for its exhibit next March. The Coliseum Company will build a new structure on this property with spacious doorways connecting with the main exhibit hall, which will add approximately 18,000 sq. ft. of floor space for exhibition purposes. This space will tend to relieve much of the congestion which has prevailed in recent years and will enable the association to more nearly meet all of the demands for space. Floor plans and other information pertaining to the exhibit are being mailed to exhibiting members of the association, and space will be assigned at a meeting of the board of directors in November.

TRADE PUBLICATIONS

HEATERS.—A four-page, illustrated bulletin, descriptive of the Breezo-Fin unit heater, has been issued by the Buffalo Forge Company, Buffalo, N. Y.

CHAIN HOIST.—An improved electric chain hoist, Model No. 20, is described in an eight-page, illustrated folder recently issued by the Yale & Towne Manufacturing Company, Stamford, Conn.

INDUSTRIAL GASES.—A booklet describing Sunray acetylene and giving a number of rules to be observed in the use of compressed acetylene, has been issued by the International Oxygen Company, Newark, N. J.

SECURITY LATCH —This latch designed to prevent grate shaker bars from working loose while being used, is described in a four-page bulletin recently issued by the United States Metallic Packing Company, Philadelphia, Pa.

ELECTRIC TOOLS.—Portable electric drills and reamers, grinding and buffing machines, etc., are described and illustrated in a 48-page booklet, Catalogue No. 32, being issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

SPEED AND FEED TESTS.—The records of the tests made on Cleforge high-speed drills at the American Railway Association convention at Atlantic City in June, are being issued in booklet form by the Cleveland Twist Drill Company, Cleveland, Ohio.

TAPPING DEVICES AND APPLIANCES.—Jarvis high-speed tapping devices, tapping machines, quick change chucks and collets, and self-opening stud setters are illustrated and described in a 32-page catalogue recently issued by the Geometric Tool Company, New Haven, Conn.

SAFETY APPLIANCES.—A few important court decisions relative to United States Safety Appliances are described in Bulletin No. 2 recently issued by the Allegheney Steel Company, Brackenridge, Pa. The ASCO self-fitting torsion spring A. R. A. journal box lid and its application are also described.

LOCOMOTIVE SUPERHEATERS.—The origin, development and results of the Elesco locomotive superheater is the subject of a 24-page illustrated booklet just issued by the Superheater Company, New York. A brief historical sketch of the Superheater Company is given, also a brief outline of the introduction of the Schmidt superheater in this country.

STORAGE TANKS.—The Conveyors Corporation of America, Chicago, has published a new booklet describing the American cast iron storage tank, which is a sectional tank for the storage of dry, loose, bulky material, such as ashes, coal, sand, gravel, etc. The booklet is illustrated with diagrams and half-tones of tanks in use, and contains a table of weights, measures and capacities.

REFERENCE BOOK.—The second edition of a 64-page, illustrated reference book of vertical turret lathe practice in railroad shops has been issued by the Bullard Machine Tool Company, Bridgeport, Conn. Installations from various shops throughout the United States are shown and, in most cases, diagrams indicate the tool equipment and operation layout. Specifications for the 24-in. and 36-in. turret lathes, the 44-in. Maxi mill and the Bullard driving box borer and facer are also given.

AUTOMATIC CONTROL OF COMBUSTION.—Catalogue No. 99, which is made up of two bulletins treating of the automatic control of combustion and systems for the automatic control of combustion respectively, has been issued by the Carrick Engineering Company, Chicago. The former bulletin contains a complete discussion of automatic control methods and systems and brings out the limitations of the various systems and why they fail. The conditions to be met in co-ordinating supply of steam with the demand are analyzed and interesting charts of steam pressures are given, the fallacy of close steam regulation is exploded, and a graphic record of damper positions shows the comparative permanence of automatic control. Complete specifications, together with diagrams and a list of equipment required for thirty-three distinct methods of automatically controlling boiler room equipment, are given in the latter bulletin.

PERSONAL MENTION

Car Department

E. Posson, engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has retired. Mr. Posson was born on July 3, 1860, at Port Washington, Wis. From 1875 to 1878 he learned the machinist trade in a commercial shop at Port Washington and from the latter date until 1883 he was a pattern maker for the Milwaukee, Lake Shore & Western, (now a part of the C. & N. W.) at Manitowoc, Wis. From 1883 to 1890 he was chief draftsman and from 1890 to 1892 he was superintendent of the Atlas Iron Works at New Duluth, Minn. On the latter date he entered the employ of the Northern Pacific as chief draftsman in the mechanical department at St. Paul, Minn. In 1903 he entered the employ of the Atchison, Topeka & Santa Fe as engineer of car construction, with headquarters at Topeka, Kans., being transferred to Chicago on July 15, 1904.

E. Posson

Shop and Enginehouse

W. S. Cozad has been appointed shop supervisor of the Packerton, Pa., shops of the Lehigh Valley. Previous to this appointment, Mr. Cozad was engaged in efficiency engineering work on various railroads, including the Chicago, Burlington & Quincy, the Michigan Central and the Norfolk & Western, and served successively as shop specialist and superintendent of apprentices and piecework of the Erie. He then became production manager of the McCord Manufacturing Company, Detroit, Mich. During the war he was engaged in repair work on the German boats and with the Bethlehem Steel Company at Quincy, Mass., building destroyers.

Purchasing and Stores

John Thomson has been appointed chief stores accountant of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

E. R. Brinton, general storekeeper of the Chesapeake & Ohio at Covington, Ky., has been appointed assistant general storekeeper, with the same headquarters.

J. H. Lauderdale has been appointed general purchasing agent of the International-Great Northern, with headquarters at Houston, Tex., to succeed C. B. Porter, resigned.

J. P. Kavanagh, general storekeeper of the Chesapeake & Ohio, with headquarters at Huntington, W. Va., has had his jurisdiction extended over the entire system.

Elmo Edwards has been appointed purchasing agent and general storekeeper of the Spokane, Portland & Seattle, with headquarters at Portland, Ore., succeeding Paul McKay, who has resigned.

W. L. Monning, assistant to the superintendent of stores of the Chesapeake & Ohio, at Huntington, W. Va., has been appointed assistant to the general storekeeper, with the same headquarters, the position of assistant to the superintendent of stores having been abolished.

A. H. Young, Jr., general storekeeper of the Chesapeake & Ohio at Clifton Forge, Va., has been appointed assistant general storekeeper, with the same headquarters, the positions of general storekeepers of the Western and Eastern general divisions having been abolished.

F. G. Prest, whose retirement as director of purchases of the Northern Pacific, with headquarters at St. Paul, Minn., was reported in the August issue of the *Railway Mechanical Engineer*, was born on January 5, 1854, at Queenston, Ont. He entered railway service in 1880 as a clerk in the purchasing department of the Northern Pacific at St. Paul, and held that position until 1882 when he was promoted to chief clerk in the same department. Mr. Prest was promoted to assistant purchasing agent, with headquarters at St. Paul, in 1891 and in 1896, was promoted to purchasing agent. He was promoted to director of purchases, with the same headquarters, in November, 1921, and continued in that capacity until his recent retirement. Mr. Prest's entire railway service of 44 years was with the Northern Pacific.

F. G. Prest

Obituary

Edmund T. Burnett, who retired as general purchasing agent of the Norfolk & Western on December 31, 1920, at Roanoke, Va., died at a hotel in New York on July 14 following a short illness. Mr. Burnett was born at Philadelphia, Pa., on December 10, 1843, and entered the service of the Norfolk & Western on April 10. 1882, as chief clerk to the purchasing agent, with headquarters at Philadelphia. He was appointed assistant to the purchasing agent on January 1, 1891, with headquarters at Roanoke and in May, 1893, he was appointed purchasing agent, with headquarters at Philadelphia. In 1896 he was transferred back to Roanoke. At the beginning of the period of federal control Mr. Burnett was appointed regional purchasing agent of the Pocahontas region, with headquarters at Roanoke, and at the termination of federal control he was appointed general purchasing agent of the Norfolk & Western, in which capacity he served up to the time of his retirement in 1920.

Aluminum Cars and Locomotives Suggested by Gen. Atterbury.—The possibility of the development of an aluminum alloy at a cost that would enable its use in locomotive and car construction, with a large reduction in weight and consequent decrease in the cost of transporting freight, was suggested by Gen. W. W. Atterbury, vice-president of the Pennsylvania Railroad, in testifying before the Senate committee on agriculture on April 19 in connection with the bid made to the government by himself, J. G. White and Elon M. Hooker for the Muscle Shoals property, which Henry Ford is also seeking. The cheap electric power available at Muscle Shoals, Mr. Atterbury said, would give an opportunity for experimentation to reduce the cost of the metal to a practicable figure.

Referring to the fact that during the war German Zeppelins were made from an alloy of aluminum and magnesium, Mr. Atterbury said that if the bid is accepted he plans to devote considerable time to research work in an effort to manufacture railroad cars out of this aluminum composition. The metal would not have the strength of high carbon steels, but it could be used as a substitute for steel in a large part of either car or locomotive construction. He said it might be possible to cut down the weight by 50 per cent; and although the question whether it is possible to produce the aluminum composition at a cost which would make its use for cars feasible would have to be demonstrated, the efficient production of aluminum at low cost is directly dependent upon cheap electricity. General Atterbury said that the metal he has in mind would have approximately 25 to 35 per cent of the weight of steel.

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The Development of Jigs and Fixtures

One of the greatest handicaps under which many railroad shops are required to work is insufficient jigs and fixtures. In many respects, the output of the shop is controlled by the number of jigs it has available and to what extent they can be efficiently used. In past years the development of jigs depended largely upon the ingenuity of the shop man. This system of development has resulted in many strange and novel contrivances which, if collected for some museum, would make an interesting exhibit. The systematic study and development of jigs and fixtures which has been made in recent years by a number of railroads has been productive of excellent results. The need for such work, with the ultimate purpose of standardization, has been brought up a number of times in the editorial columns of the *Railway Mechanical Engineer,* because the results already achieved indicate that increased efficiency in shop production may be effected by the railroads and that the work is well worth the cost.

In the development of jigs and fixtures a great deal more could be accomplished by co-operating with the machine tool manufacturers. Many of the manufacturers of machine tools for railroad shops have made intensive studies of railroad shop requirements and after extensive experiments have made available for the users of their machines, jigs and fixtures designed to handle various kinds of work. These jigs usually cost less than 25 per cent of the price of the machine, yet in a majority of cases they will double production. As a rule the manufacturers are in a far better position to develop, design and build fixtures for the tools they make than the individual railroad shop. They have available information and data that has been collected over a long period of years and in the case of grinding and milling machines few railroad shops have any information upon which a thorough study, relative to the development of jigs and fixtures, can be based.

Mr. Stone as a Capitalist

Railroad men familiar with the usual attitude of the unions in wage negotiations must have been mildly amused when they read in the daily press the correspondence between Warren S. Stone, of the Brotherhood of Locomotive Engineers, and John L. Lewis, the head of the United Mine Workers, over the refusal of Mr. Stone to pay union wages in the mines owned by members of the enginemen's brotherhood and the consequent shut-down of these mines. Mr. Stone avers that the mines cannot be operated at union wages in competition with non-union mines without entailing a loss to the stockholders, members of the enginemen's union, who own the mines. Mr. Lewis counters this with contention that this is a problem to be solved by the management of the mines, for which miners are not responsible, since they have no voice in it. This is a well-known obstruction, and one which has wrecked many a wage conference between union organizations and the managements of frankly capitalistic enterprises. Mr. Stone and his labor union followers are facing a capitalist's problem in a typical capitalistic way. The question is, now that Mr. Stone has recognized the validity of this viewpoint as it applies to his mines, will he also recognize it in negotiations which he enters as a union man, and will the officers of the other railway unions be inclined to agree with him? It is one thing to set up a high standard of what wages and working conditions should be and quite another to find the money with which to meet this standard. Mr. Lewis's idea that finding the money is essentially a managerial function is an old one which heretofore has been accepted almost as an axiom in trade union policy. Mr. Stone's position in this controversy should show the fallacy of the notion and make it clear to unionists everywhere that they must either do all in their power to aid management in making production remunerative or be willing to work for the wages that the management can pay. The only other alternative is that now in effect in the enginemen's coal mines—a total shut-down with no returns either for the workers or the owners.

Making Better Workmen

Much interest was aroused by the results of the apprentice competition which was held by the *Railway Mechanical Engineer* last year. A number of contributions, including those of the prize winners, were published in the early months of this year. Other articles, which we had decided to use and which contain constructive and thought-provoking suggestions, were temporarily laid aside during the summer months while we published the series of articles describing the methods and practices of the Santa Fe apprenticeship department. With this issue we resume the publication of those contributions to the apprentice competition which were awarded honorable mention.

For some reason very few contributions were received in our apprentice competition from the young men in the boiler shop. We are particularly gratified, therefore, to present elsewhere in this issue a constructive discussion from one of the boilermaker apprentices of the Erie Railroad. At the risk of becoming tiresome, may we again reiterate the statement that if the railroads are to make the best progress in training apprentices, they must have an appreciation of the boys' viewpoint, in order to know how best to reach and inspire them to put forth their best efforts. Mr. Wylie has some excellent suggestions to this end, which are well worth consideration.

It is interesting to note, also, that Mr. Wylie has placed special emphasis upon the necessity for the technical training of apprentices. Mechanics in some of the countries in continental Europe have always been noted for the thoroughness of their training and their fitness as all-around workmen. One reason for this is not hard to find. On visiting a large shop in Russian Poland, the officers in charge apologized for the way in which the apprentices were being trained. In-

quiry indicated that much the same methods were being used in this particular shop as in the average American railway shop. This was because the shops and the community were comparatively new and schools for technical instruction had not yet been inaugurated by the community. The officer explained that under normal conditions the boys would be required to complete a certain amount of technical training in the schools before they would be allowed to learn the practical details of the trade in the shops. Some of the railroads in this country have awakened to the necessity for providing technical training in the school room, either on the company premises or through outside agencies, but in co-ordination with the practical shop training. Many of our railroads, however, have failed to give this matter proper consideration, and as a result the graduate apprentices, unless they have followed special courses of study as individuals, are not as thoroughly trained for their life work or as capable as they should be. A greater appreciation of the value of such training on the part of the railroads will prove a large factor in maintaining the interest of the apprentices.

The Foreman's Job—A Competition

There has been a vast amount of discussion in recent years concerning the fact that the foreman, because he deals directly with the workers, occupies a tremendously important position in a large organization. Frequently he is the only man in the official family with whom the workers come in contact and they appraise and judge the entire organization from the standpoint of their dealings with him. On the other hand, the foreman is frequently the only channel through which the men may be informed and educated as to the policies and desires of the management. As the organizations have grown in size and have become more and more complicated with resulting frequent misunderstandings between the managements and the men, the position of the foreman has become more and more important. Unfortunately this was not recognized to any great extent and too little attention was paid to cultivating the foreman and preparing him to meet the responsibilities of his position in a big way. The past two or three years have witnessed a great awakening in this respect and many railroads are adopting constructive measures to overcome this weakness and place proper emphasis upon the importance of the foreman's position.

The *Railway Mechanical Engineer* desires to promote a constructive discussion of this whole question and announces a competition in which a first prize of $50 and a second prize of $35 will be awarded for the two most constructive articles received at our office in New York on or before December 1, 1924, on the opportunities and responsibilities of the foreman. In other words, what are the opportunities of the foremen in the way of strengthening the organization and giving the best possible account of themselves? Just how are these opportunities to be measured? What are the responsibilities of a foreman in the railway mechanical department—not in the way of detail methods and practices, but in getting the largest and best service from the workers, not alone in the selfish interests of the company or of himself, but to the mutual advantage of all concerned—the public, the men, the management and the owners?

When this topic was discussed at one of our staff meetings, the opinion was expressed that a competition of this sort would bring out only a theoretical discussion which would fail to make a distinct impression upon our readers and would not serve any constructive purpose. In answer to this, it was pointed out that events which have taken place in the railway mechanical field during recent years have served to emphasize the absolute necessity of the foremen facing up to their jobs in a large way and with a real comprehension of their great opportunities and of the heavy responsibilities which rest upon them. It was suggested that many foremen have been studying this whole question critically and that they are in a position to contribute specific facts and human interest incidents to back up their ideas which will be extremely valuable and helpful to their associates in other departments or on other roads. It is with this thought in mind that we are inviting the foremen to help us develop and promote a constructive discussion of this whole question.

The Cost of Delays

Under normal operating conditions, there is probably no one factor upon which may be placed more responsibility for delays to equipment held in shops for repairs than a lack of material with which to complete the work. It is an element which to some extent enters into and tends to interrupt the otherwise smooth operation of practically every railroad repair shop. The shop superintendent could ask for no more nearly ideal condition than to have available an unlimited stock of materials at all times. Such a condition might also help to eliminate many of the difficulties by which the general storekeeper is beset, but to maintain an adequate stock without accumulating an excess stock is the storekeeper's big problem. Fortunately, the general storekeeper or purchasing agent is able to show just what he can save in dollars and cents by a reduction in material stocks, whereas, on the other hand, the shop superintendent is usually at a loss to know how he can show up the actual cost of delayed repairs which may be occasioned by not having material.

When there is a heavy demand for power and the shops are operating at full capacity, delays to equipment undergoing repairs represent an actual loss in dollars and cents which may be evaluated by taking into consideration the rental value of a locomotive or car, and the shop space, as well as the increased labor cost due to disruption of the repair schedule, but it is only under such conditions that the delay represents an actual loss. Certainly a delay charge against a locomotive being repaired before placing it in storage or a charge for shop space, which would not otherwise be used, could never be justified.

The installation of a shop cost control system followed by a thorough analysis of the data which would then be available, would undoubtedly point out to the shop superintendent some way in which figures may be compiled to show the management just what these delays cost at a time when they represent an actual loss and would enable it to determine whether or not one department was economizing at the expense of another. Under such conditions, a scheme of shop cost accounting, showing in dollars and cents just what it costs to have a locomotive or car held in shop awaiting material, might be worth while, but would it not be better to direct attention to the institution of methods that would prevent such an occurrence?

An editorial in the *Railway Mechanical Engineer* some time ago suggested the desirability of studying this situation with a view to striking a proper balance between the objectives of the mechanical and stores departments and creating a better mutual understanding of the problems of both departments. Subsequent comment served to bring out some more or less biased opinions. The outstanding feature of the discussion was the tendency of the representatives of each department to lay stress upon their own particular troubles without offering any constructive suggestions as to how the other department might help to eliminate them. Is it not, after all, merely a question of complete co-operation?

One general storekeeper made the statement that the best possible insurance against delays attributable to shortage of material is a strongly organized service of supply. The op-

portunities for a thoroughly efficient stores organization, however, do not lie entirely within the jurisdiction of the stores department. There are many ways in which the mechanical department may assist in increasing stores department efficiency and in doing so serve its own purposes. The stores department is not able to serve to the best advantage without the possession of complete and timely information as to the requirements of other departments, not only as to the quality and quantity of material wanted, but a knowledge as to the actual time it is wanted as well. This naturally leads to the question of how well organized the shop may be, particularly in respect to the ability to anticipate probable future requirements of material.

The scheduling of railroad shop work has attracted considerable attention in recent years and some remarkably efficient systems have been developed and put into successful operation. Primarily, scheduling systems have been introduced to facilitate shop output, but if the possibilities of utilizing the schedule as an indicator of future requirements have not been considered, then it has failed to serve its full purpose.

A well-organized repair shop in which scheduling methods are used should be able to anticipate its future requirements with sufficient accuracy to furnish complete information to the stores department far enough in advance so that the necessary material could be secured and be available when needed. Having been forewarned of an approaching demand, a well-organized stores department should have no incentive for not furnishing the necessary material to meet the schedule.

Sound Judgment is Essential

A gang of skilled mechanics is stationed at the locomotive terminal to inspect locomotives as they come on the inspection pit and report any defects. Furthermore, the engineman, at the end of his run, reports the defects some of which can only be determined when the locomotive is working. These reports are sent to the office of the enginehouse foreman for the specific purpose of directing him and his assistants as to what repairs should be made on the locomotive so that it may be again dispatched and complete its run without a breakdown. But do these reports always accomplish the purpose for which they are intended? It is not unusual for an engineman to report that his locomotive would not make steam due to the flues being stopped up, dirty front end, valves out of square, or the diaphragm pipe out of line. As a usual rule defects of this nature do not develop on a single trip; upon investigation, it will probably be found that they have been consistently reported by previous enginemen. The natural question is, why have they not been repaired? The answer is that the gang foreman who received the engineman's work report passed these defects as O.K. for service. Again, locomotives break down or lose time on the road due to hot main pins or driving boxes, air pumps failing to keep up the required pressure, dirty feed valves, rods pounding badly, or other defects of a similar nature, which are reported by the locomotive inspectors. It is not unusual to develop the fact that such defects have been passed as serviceable. When the gang foreman responsible is pressed for an explanation as to why he permitted such locomotives to be marked up for their runs he will defend himself by stating that he did not have the material to make the repairs; or he was short of power; or he did not have sufficient time; in a few cases he may admit that he thought that the locomotive would make another trip and that the fellow at the other end of the division would repair it. The trouble is that there is too much of the prevailing spirit of taking a chance and depending upon the other fellow to do his work. Again, frequently, the foreman is not able to exercise good judgment in deciding on what should be repaired and what should be passed as serviceable.

A good enginehouse gang foreman should know a locomotive and be able to use sound judgment in passing on work reports. If a locomotive is dispatched on a run, and due to existing defects, a breakdown occurs it will cost money, time, and often human life. There is nothing which will more quickly arouse the ire of the traveling public than to have the train lose time because of defective equipment. If it is a frequent occurrence the railroad soon gains a bad reputation. One of the ways to help overcome such a situation is to use great care and discretion in selecting men to fill positions of gang foremen in the engine house.

New Books

THE MODERN FOREMAN. *By Robert Grimshaw, M. E., 297 pages, 5¾ in. by 8½ in. Price $2.50. Published by the Gregg Publishing Company, New York.*

The object of this book is to show the important part the foreman plays in increasing the efficiency of modern industrial plants. A comparison is given between the foreman of the past and present and his responsibilities to his employer, the workers and himself. Three chapters are devoted to men in the ranks and problems pertaining to them which the foreman must fundamentally understand. This is followed by an interesting discussion of the art of handling men with the object in view of obtaining the largest amount of production per man and still keep them contented and interested in their work.

Considerable space is given to the duties of the foreman. This includes a detailed discussion of the best methods of performing the various duties which confront the foreman during his daily routine. Considerable discussion has taken place in recent years as to the amount of clerical duties the foreman should have burdened upon him. The author, in a clear and concise manner, discusses the amount and best methods of performing this duty. In chapters nine and ten, it is pointed out that the foreman should aim to eliminate waste and also should study the most modern factory methods. These factors should be thoroughly understood in order that a foreman may function properly.

What the foreman should have and what he should know is covered in the two largest and most interesting chapters in the book. The importance of his mental training, his physique, his character, his personality, his imagination, his loyalty, etc., are interestingly discussed in these chapters. It is further pointed out that the foreman should have a general knowledge of human nature, of psychology, of teamwork, of management, etc., in order to successfully perform his duties and to prepare himself for further advancement.

The last 14 chapters deal with after thoughts which came to the author's mind during the sale of the first edition of this book. These chapters dwell on the foreman personally and discuss the peculiarities of various types of foremen. The book is written in a very interesting and entertaining style and should be read by every man who is in an executive capacity or by those in the rank and file who are ambitious to assume responsibility.

AIR BRAKE INSPECTORS' HANDBOOK. *By Carl Glenn, air brake inspector Chicago, Rock Island & Pacific. 200 pages, illustrated. 5 in. by 7¼ in. Price $2.00. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.*

The Air Brake Inspectors' Handbook, which is the second volume of the Railwaymen's Handbook Series, is a worthy companion to the Car Inspectors' Handbook reviewed in the September, 1924, issue of the *Railway Mechanical Engineer.* The author has accomplished his purpose to provide a handy reference book for enginemen and air brake

inspectors, giving prescribed tests by which to locate defects as the various symptoms appear. The tests described are useful to any man whose work requires him to operate or repair air brake equipment, particularly, as they cover all types of equipment in general use.

The text of the book contains 14 chapters on such subjects as air compressors, pump governors, the G-6 brake valve and double check valve, feed valves, triple valve defects, PC and ET equipment, the No. 6-A ET equipment, ET piping, air signal equipment and a chapter on the UC No. 12 universal passenger control valve. An interesting chapter is devoted to common defects occurring in the empty and load brake. This type of equipment is usually a difficult problem to the air brake man on account of the disparity between loaded and empty weights of modern equipment. Particular attention has been paid in this chapter to defects in the K-2-L triple valve and also in the H-3 change-over valve. A chapter has also been added in which the author has gone into the various interpretations and rulings, as applied to brake and signal equipment, of the locomotive safety laws. The volume is quite complete and should be of real service to railroad men, concerned with the operation or maintenance of air brake equipment.

PRACTICAL MATHEMATICAL ANALYSIS. *By H. Von Sanden, Professor of mathematics at the University of Clausthal, with examples by the translator, H. Levy, M.A., D.Sc., F.R.S.E., Professor of Mathematics, Imperial College of Science and Technology, London,* 195 *pages, illustrated* 5½ *in. by* 8½ *in. Price* $4.50. *Published by E. P. Dutton & Company, New York.*

The book presents to the reader an able and stimulating survey of the methods by which the solutions of any given problem may be evaluated in numerical form. The author has given preference to those methods which are capable of a very general application in the teaching of mathematics, and consequently has devoted considerable space to the treatment of empirical function.

The general theory and the three positions of the slide-rule is discussed in Chapter II. The same chapter contains an explanation of the construction and the use of the calculating machine. Other subjects treated in the book are rational integral functions, and their extrapolation and interpolation; numerical differentiation and integration; mechanical quadrature; solution of equations, linear, transcendental and non-linear and the analytical approximation of empirical function.

THE SUPERVISION AND MAINTENANCE OF STEAM RAISING PLANT. *By Charles A. Suckan,* 342 *pages,* 6½ *in. by* 9½ *in., illustrated, bound in cloth. Published by D. Van Nostrand Company, New York, Price* $8.00.

The present high cost of fuel is emphasizing the imperative need for an organized system of boiler house control. The fuel bill is the largest item of operating expense, and any means of reducing it is worthy of the closest attention. In this book the author has brought out the necessity for the efficient operation and maintenance of steam generating plants and has presented such information as will assist power plant owners and engineers to operate their plants as efficiently as possible under existing conditions in the simplest possible manner by avoiding a theoretical discussion of the subject. This volume will be found valuable as a reference work. The text is divided into two general parts, the first dealing with supervision and the second with maintenance. A practical discussion of the economical use of fuels and the use of fuel-saving devices is followed by a discussion of the operation of auxiliaries and the handling of fuel and ashes. A section of Part I is devoted to the management and duties of the power plant operating staff. Part II covers the inspection and maintenance of equipment.

PROCEEDINGS OF THE INTERNATIONAL RAILWAY FUEL ASSOCIATION 1924. *Edited by the Treasurer, J. B. Hutchinson,* 6000 *Michigan Avenue, Chicago, Ill.* 487 *pages, bound in leather.*

This book contains the proceedings of the Sixteenth Annual Convention of the International Railway Fuel Association which was held in Chicago, May 26 to 29, 1924. The reports submitted include the Proper Distribution of Locomotive Fuel; Feed Water Heaters; Symposiums on New England, Australia, Canada, South West Territory and other Central States and Mid-Continent; Oil and Coal Locomotive Fuel; Firing Practice; Fuel Stations; Coal Storage; Mining, Preparation and Inspection of Coal for Locomotive Use; Co-operation with the American Railway Association; Purchase of Coal by the Railroads; Fuel Loss at Locomotive Terminals, and What is the Responsibility of the Division Superintendent in Fuel Conservation?

What Our Readers Think

A Fast Job in the Roundhouse

MILWAUKEE, WIS.

TO THE EDITOR:

In almost every issue of the *Railway Mechanical Engineer* I read with considerable interest of work being done in a very short time, or in a better way than the general practice. Such articles are most helpful to those directly responsible for locomotive repairs for it aids them in "doing the job" and returning the locomotive to service in less time and in many cases with less effort.

I have in mind the renewal of a front side rod pin on a Pacific type locomotive which was made here in six hours. The new pin was furnished finished except for the wheel fit. The pin to be removed and applied was of the cup shaped type, the depression being made in the pin to secure a cup shaped washer by means of a 1¼-in. bolt extending through the entire length of the pin. To remove the pin the engine was spotted and the rods removed. The engine was again spotted on the right back center to place the pin in position for removal. Blocks were then placed between both of the front driving boxes and pedestals and the brakes were slacked. While two men jacked up the engine the side rod pin was cut off flush with the wheel center, then cut in as far as possible at the front and back sides of the bolt hole to within ¼-in. of the wheel bearing. It was necessary to cut the balance of the pin from the outside, as the mechanics were not able to cut the entire distance through the pin. After completing the cutting operation, the pin was cooled and then driven out with a long ram, which extended through the spokes in the left front driver, and a sledge. This operation required little effort. The wheel center was then thoroughly cooled and calipered and one of the mechanics finished the wheel fit of the new pin while the tire and wheel center were being heated. An ordinary kerosene heater was used to heat the hole in the wheel for the new pin. The side rod was taken to the shop where the bushing was bored to fit the new pin. Heating the wheel center required about 40 minutes. A thin coat of white lead was applied to the wheel fit of the new pin which was slipped into the wheel. The rods and other parts were then applied to the locomotive.

There were two machinists and two helpers on this job which was started at 7:00 a.m. The locomotive was ready to depart on a train at 3:00 p.m. No work was done between 12:00 noon and 1:00 p.m. No arrangements had previously been made to renew this pin as the locomotive had arrived on the previous night.

We have applied several pins by this method and it has proved very satisfactory. ROUNDHOUSE FOREMAN.

Heavy Freight Locomotives for the Reading

Consolidation Type Weighs 314,950 lb. and Has Unusually High Tractive Force of 71,000 lb.

In building the order of 25 Consolidation type locomotives for the Reading Company in the latter part of 1923 the Baldwin Locomotive Works turned out the heaviest of this type which had been constructed in its plant up to that time. These locomotives have a total weight on drivers of 284,190 lb. which averages 71,000 lb. per pair. The development of the Consolidation type on the Reading presents some interesting features and a comparison of the latest group, designated as Class I-10-S A, with previous Consolidations built for this road shows the remarkable increase in capacity effected since 1880. The accompanying table gives a comparison of the principal dimensions.

As compared with the locomotives built in 1880, Class I-10-S A shows an increase in total weight of 208 per cent and in tractive force of 262 per cent. With a ratio of adhesion of four, the weight on drivers of the new locomotives is fully utilized for traction purposes.

Fuel and traffic conditions on the Reading are largely responsible for the continued use of the Consolidation type in heavy freight service. The fuel used is a mixture of fine anthracite and bituminous coal, which can be economically burned in a wide firebox placed above the driving wheels; while the traffic consists largely of coal which is hauled in heavy drags at moderate speeds. With the excellent track conditions on this road, and with generally favorable grades from the mining regions to tide-water, eight-coupled locomotives handle the heaviest trains that can be economically operated.

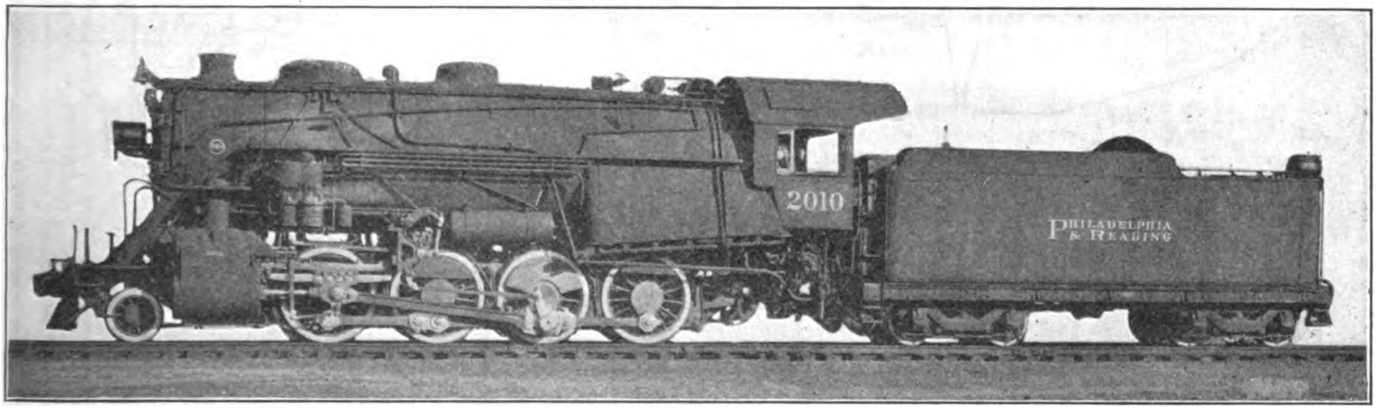
The new locomotives are a direct development of Class I-9, built in 1919, and have many features in common with them. The increase in total weight is 12 per cent and in tractive force 16 per cent. Flanged tires are used on all the wheels, and are spaced transversely to permit the locomotives to pass curves as sharp as 22 deg.

The boiler is of the Wootten type, with a conical ring forming the front half of the barrel, and a maximum diameter of 96 in. The center line is placed 10 ft. 2 in. above the rail. The firebox has a combustion chamber, across the throat of which is built a brick wall 26 in. high. A Duplex stoker is applied, and the grate is of the rocking pattern, with drop plates front and back. The ash pan has a single hopper of large capacity, with a steam blower pipe for cleaning. A special feature that should be noted in connection with the boiler is the Economy front end, patented by I. A. Seiders, superintendent of motive power and rolling equipment of the Reading. The sparks are broken up by means of a breaker plate, consisting of a slotted plate fitted with deflecting vanes, which is placed under the superheater damper and in front of the tubes. The netting frames are most substantial in construction, and the device has proved very effective in preventing the setting of fires due to escaping sparks.

Two of the locomotives in the group are equipped with the Sellers exhaust steam injector.

As in the Class I-9 Consolidation type locomotives, the cylinders are cast separate from the saddle. The valve chambers are bushed for 13-in. piston valves, but are of sufficient size to take valves 14 in. in diameter. The valves are set with a travel of 6½ in. and a lead of ¼ in.; they have a steam lap of 1 in. and an exhaust clearance of 1/16 in. They are operated by Walschaert gear, controlled by the Ragonnet power reverse mechanism. The pistons have rolled steel heads and cast iron bull rings, and the driving and engine truck axles, crank pins, piston rods, and connecting rods are of quenched and tempered steel; the driving axles are hollow bored. Fifty per cent of the reciprocating weight is balanced.

The main frames are each cast in one piece, and with the

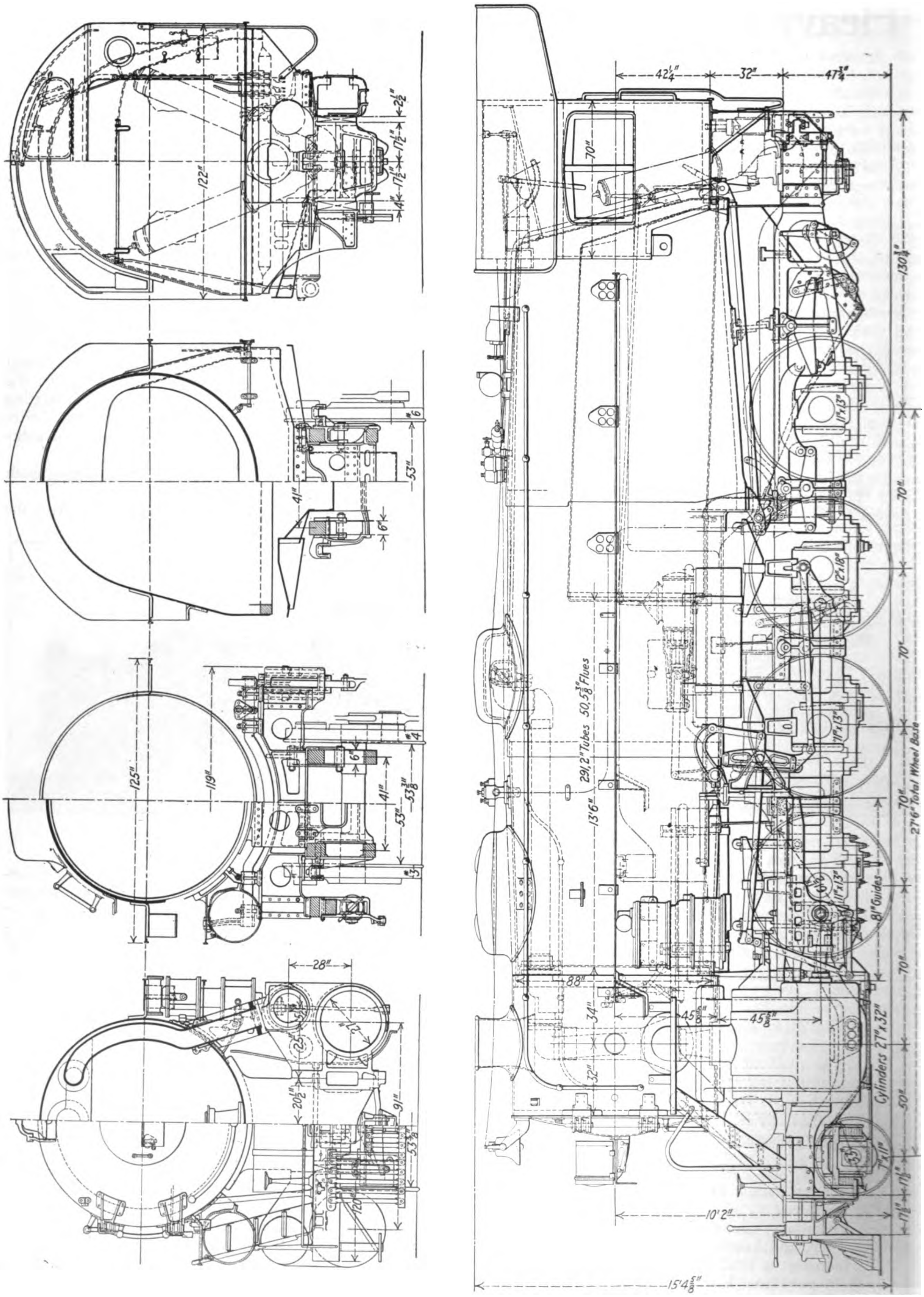


Consolidation Type Locomotive Built by the Baldwin Locomotive Works for the Reading

The Development of the Consolidation Type on the Reading

Date built	Cylinders, in.	Drivers, in.	Steam pressure, lb.	Grate area, sq. ft.	Water heating surface, sq. ft.	Superheating surface, sq. ft.	Weight on drivers, lb.	Weight total engine, lb.	Tractive force, lb.
1880	20 by 24	50	120	76	1,357	...	90,300	104,100	19,600
1890	22 by 28	50	140	76	1,818	...	135,000	150,000	32,250
1900	22 by 28	56	200	47.5*	2,130	...	147,600	164,300	41,200
1905	22 by 30	61½	210	90	3,209	...	204,000	226,250	42,200
1919	25 by 32	55½	200	94.9	2,655	575	250,800	281,100	61,000
1923	27 by 32	61½	220	94.5	3,315	778	284,190	314,950	71,000

*Designed for burning bituminous coal.



Elevations and Sections of Heavy 2-8-0 Type Locomotive for the Reading Company

transverse braces are of most substantial construction. The front frames sections are in the form of slabs, which fit between the central saddle and the cylinder castings. The main driving boxes are of the extended type, and self-adjusting wedges are used in the main pedestals.

The tender frame is built up, with 10-in. and 12-in. longitudinal channels and steel plate bumpers. The tank carries 9,500 gal. of water and 15 tons of coal. The trucks are of the equalized pedestal type, with forged steel wheels.

These locomotives have a width over the cylinders of 10 ft. 5 in., and a height over all of 15 ft. 4⅝ in.

Table of Weights, Dimensions and Proportions.

Railroad	Reading
Type of locomotive	2-8-0
Service	Freight
Cylinders, diameter and stroke	27 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	Piston, 13 in.
Weights in working order:	
On drivers	284,190 lb.
On front truck	30,760 lb.
Total engine	314,950 lb.
Tender	187,050 lb.
Wheel bases:	
Driving	17 ft. 6 in.
Rigid	17 ft. 6 in.
Total engine	27 ft. 6 in.
Total engine and tender	66 ft. 10¼ in.
Wheels, diameter outside tires:	
Driving	61½ in.
Front truck	33 in.
Journals, diameter and length:	
Driving, main	12 in. by 18 in.
Driving, others	11 in. by 13 in.
Front truck	7 in. by 11 in.
Boiler:	
Type	Conical
Steam pressure	220 lb.
Fuel, kind	Anth. and bit. mixed
Diameter, first ring, inside	88 in.
Firebox, length and width	126¼ in. by 108¼ in.
Tubes, number and diameter	291—2 in.
Flues, number and diameter	50—5½ in.
Length over tube sheets	13 ft. 6 in.
Grate area	94.5 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	327 sq. ft.
Arch tubes	
Tubes and flues	2,988 sq. ft.
Total evaporative	3,315 sq. ft.
Superheating	778 sq. ft.
Comb. evaporative and superheating	4,093 sq. ft.
Tender:	
Water capacity	9,500 gal.
Fuel capacity	15 tons
General data estimated:	
Rated tractive force, 85 per cent	71,000 lb.
Cylinder horsepower (Cole)	2,886
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	90.3
Weight on drivers ÷ tractive force	4.0
Total weight engine ÷ cylinder hp	111.7
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp	1.45
Tractive force ÷ comb. heat. surface	17.3
Tractive force × dia. drivers ÷ comb. heat. surface	1,066.8
Cylinder hp. ÷ grate area	30.5

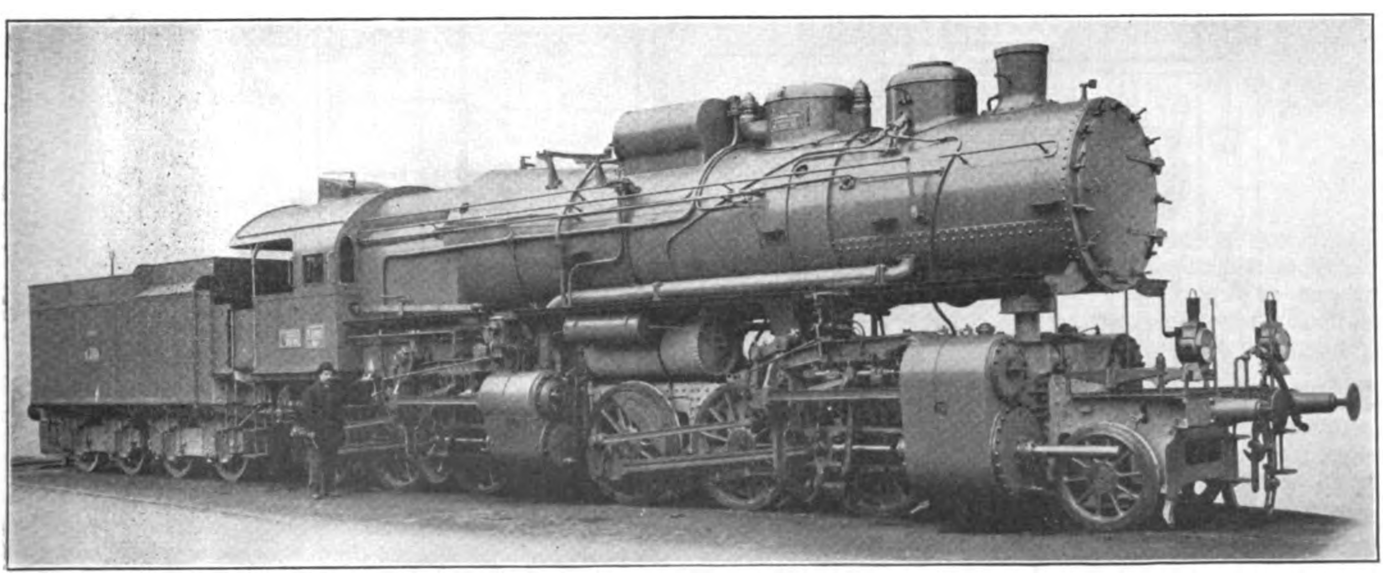
Brotan Boiler Applied to Hungarian Mallet

Adverse Water Conditions Led to the Adoption of This Type, Which Has Proved Successful

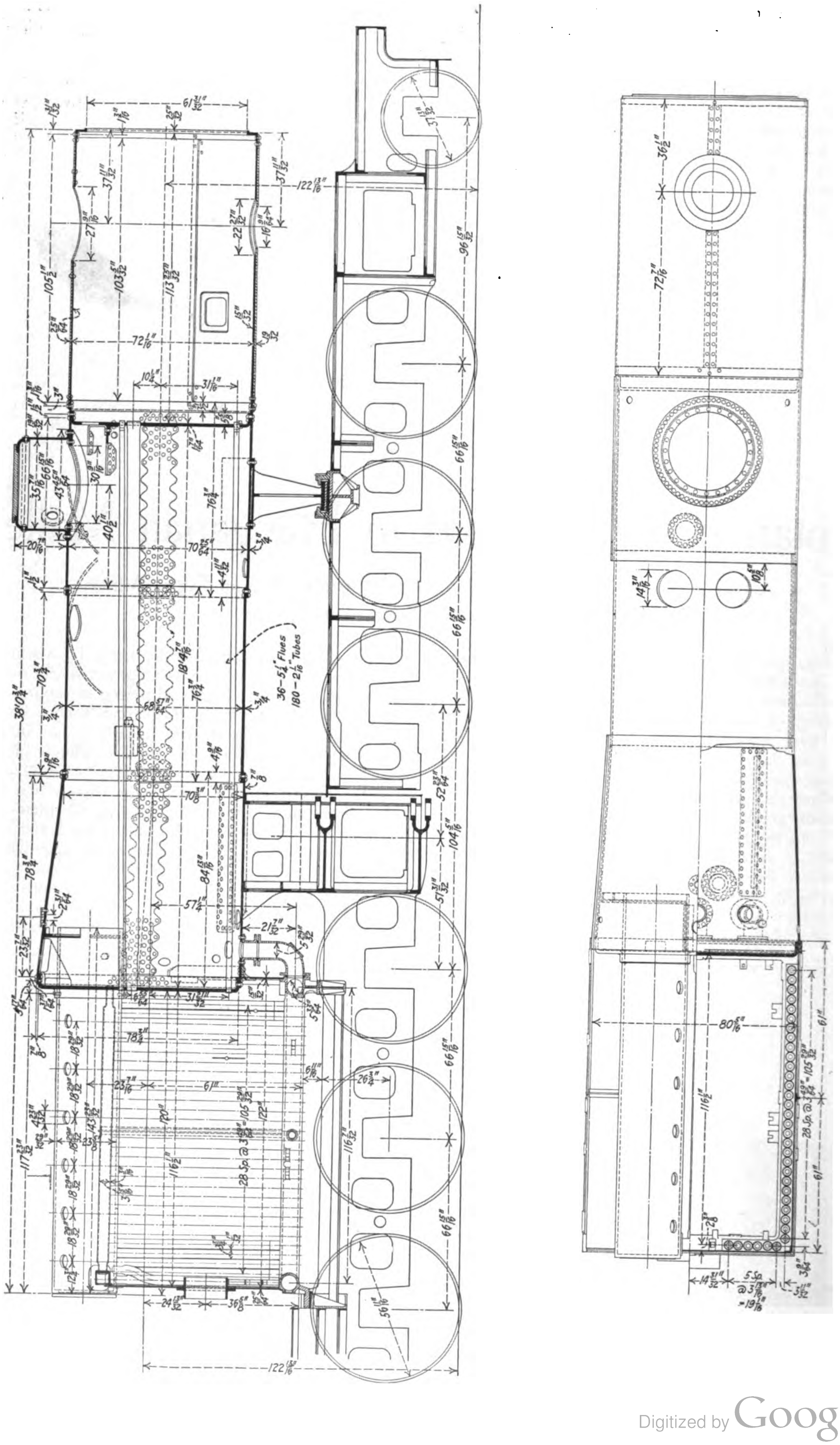
The Hungarian State Railways had handled practically all of its heavy express and passenger trains on the Fiume-Moravica section of the Budapest-Fiume line with locomotives of the 2-4-4-0 type, and the freight trains with 0-6-6-0 type locomotives until about 1914. Increased traffic conditions since that time created the necessity of developing a locomotive of greater power and capacity. The locomotive illustrated and described in this article was designed to handle traffic in the above-mentioned territory and was the first one of its type to be built in the shops of the state railways of Budapest.

Difficulties had been experienced with the boilers on locomotives previously used in this district because of hard water and because of the highly satisfactory service which the Brotan boiler had rendered on some express locomotives, it was decided to embody it in the design of this new Mallet. Since this first locomotive was constructed, 59 more of the same design have been built and placed in service.

This particular design of the Brotan firebox boiler has a greater heating surface than is usually found in European locomotive boilers. The barrel of the boiler is in three sections; the middle section has a diameter of 68 29/32 in. and the plates are ¾ in. thick, while the rear section is conical with a maximum diameter of 78¾ in., the plates being ⅞ in. thick. The circumferential seams of the boiler are lapped and double riveted; the longitudinal seams have double straps of unequal width and are triple riveted. The copper tube sheet of the firebox is 1 3/16 in. thick, the front tube sheet is of iron 1 7/64 in. thick. The steam dome is 20 7/16 in. high and has a diameter of 35 7/16 in.; it consists of two



Mallet Locomotive with Brotan Boiler Built for Heavy Freight Service



Elevation and Plan View of Mallet Locomotive on Hungarian State Railway

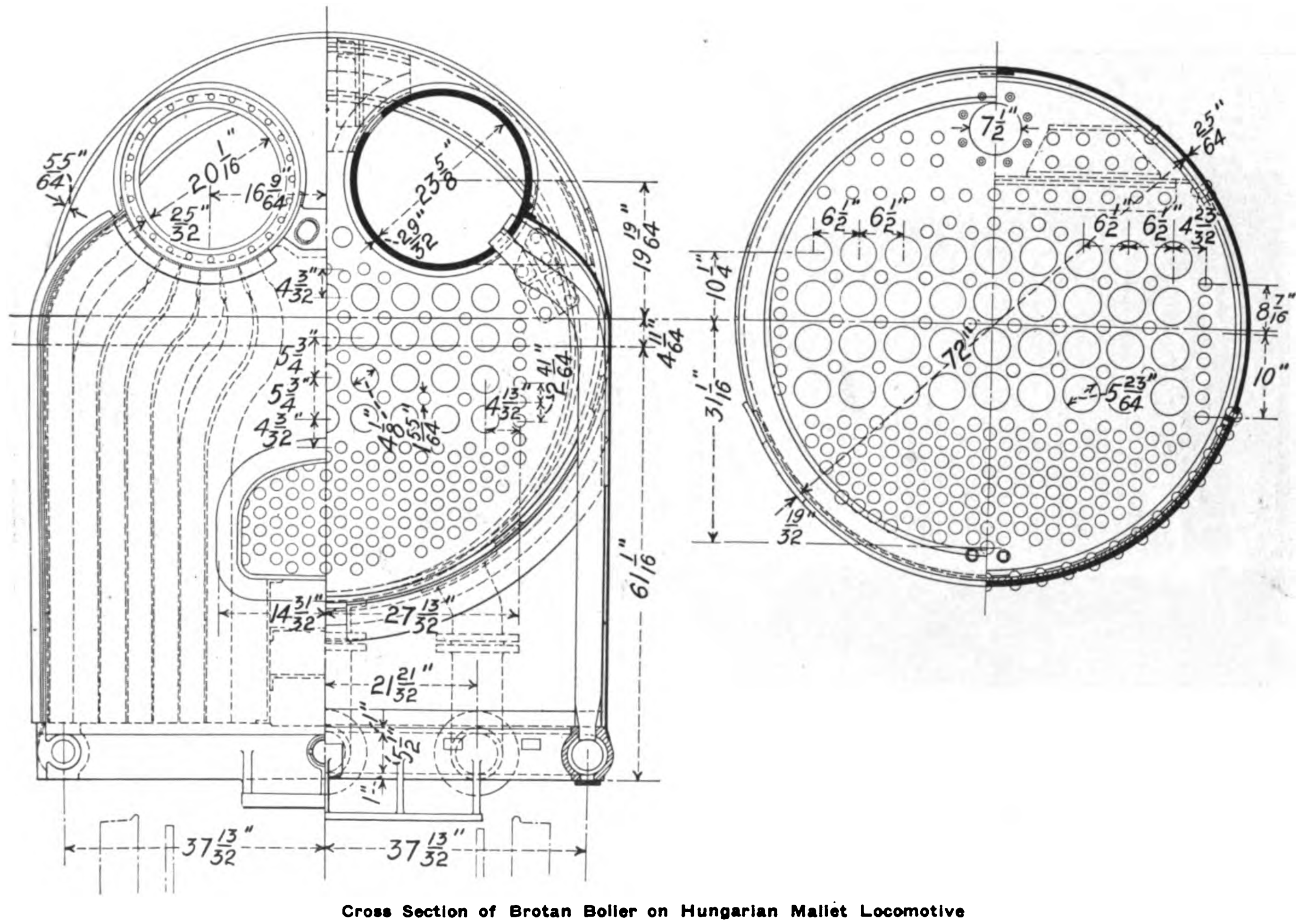
parts; viz., the flanged shell which is 19/32 in. thick, and the dome which is 7/8 in. thick and which has a cover 25 9/16 in. in diameter. The smoke box is built up of two plates and has a door consisting of two dished plates which is held against the cast steel door frame by 12 clamps. Connecting with the stack, which is not continued down inside the smoke box, is a conical, tiltable spark arrester extending down to the exhaust pipe which ends on a level with the center of the boiler. Behind the opening for the stack is fitted a half conical smoke duct.

The throttle valve on the steam dome is a double disc gate valve; two safety valves of four-inch diameter, with a high lift, are fitted on a special pad back of the dome. On account of the size of the boiler two strainers, each with six cells of 21 5/8 in. diameter, were fitted, the feed water being led to these through a feed-head by means of a non-suction steamjet pump.

The Schmidt type superheater has 36 units in four rows of each side, while forward a fireproof wall completes the enclosure. The fire door is a sliding door in halves, the opening being formed by a cast steel frame; combustion with but little smoke formation is attained by a long fire dome; a tilting grate serves readily to remove the slag formed by inferior coal.

The saddle connecting the cylinders of the rear truck is 59 in. deep and is rigidly riveted to the last boiler section. Thus secured, the boiler rests by means of a front and rear sliding surface of the base frame on the tie girders of the trucks, the last one of which is provided with a brass liner. Ahead of the middle axle of the forward truck is located a cast steel girder having an inside riveted connection with the boiler at the top and resting at the bottom on bushed guides. Two coupled plate springs 70 7/8 in. long, having 3 15/16 in. side play bring the forward truck back to the mid position.

The ash pan has a horizontal bottom divided into two



Cross Section of Brotan Boiler on Hungarian Mallet Locomotive

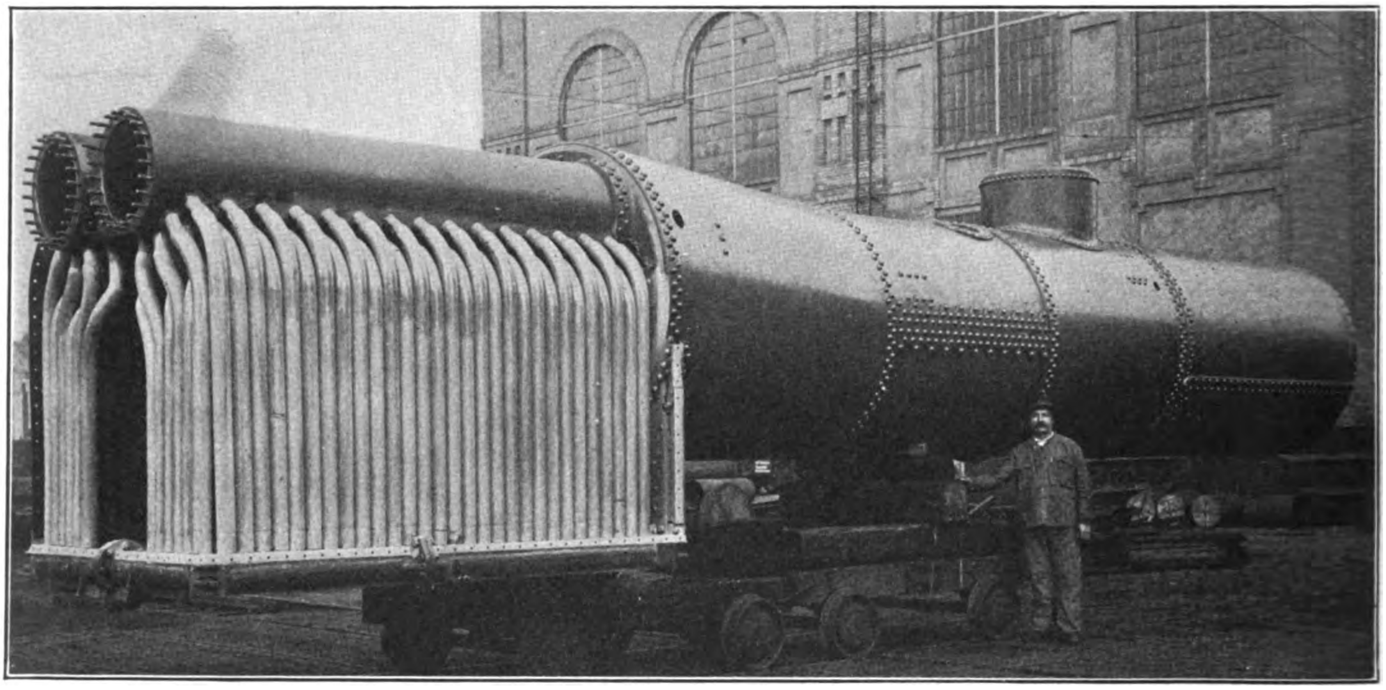
nine each. The Brotan type firebox, the largest of its kind, is 122 in. long between protecting plates and 79 1/2 in. wide. The cast steel base frame is built up in four sections with flanged joints and its front end is connected to the boiler by three elbows. In later construction the base frame is in one piece. The side walls of the firebox are formed by seamless drawn wrought iron water tubes which end in two separate headers, and are connected with each other at the rear by a coupling piece. To insure tightness the headers project into the boiler for a distance of 22 9/16 in. and are there supported by heavy angle bars. Furthermore, to better shut off the gases of combustion toward the top, two more horizontal water tubes were built in between the two headers, reaching from the rear coupling piece to the tube sheet. The rear wall of the firebox is formed by six water tubes on sections by a recess for the middle axle of the rear truck; each of the sections has two trap doors in the bottom which can be operated from the cab. A branch line from the left pressure pipe of the steam jet pump serves for sprinkling the coal while one from the right serves the same purpose for the ash pan.

Each wheel base consists of two continuous frames 1 1/8 in. thick, 43 5/16 in. apart. Due to the frame for the high pressure cylinders being located under the firebox, the horizontal stiffening of this main girder was limited, but it was possible to fit, in addition to a horizontal angle frame above the closed driving box openings, several wrought iron stiffeners between the wheels at the lower edge of the frame.

The driving axle which is curved to a radius of 76 in., is fitted with upper supporting springs of eleven plates each and

has 1 21/32 in. play on each side. The supporting springs of all driving axles are below and are connected up by two spring links; they consist of twelve plates with 35 7/16 in. hanger centers. The last wheel of the forward truck has smaller flanges, the first wheel of the rear truck has ½ in. lateral on each side, and the second and seventh axles of the locomotive run in fixed bearings. The flanges of the first, second and fifth wheels, which are subject to the most wear on curves, are lubricated. The connection of the two truck frames is located somewhat ahead of the center of high pressure cylinders, there being long swivel pins in the cross tie of the latter.

For the distribution of steam, outside valve gear of the Hensinger-Walschaert type and piston valves are employed. A hand operated starting slide valve at the right hand side of the boiler takes the live steam from the steam supply pipe and allows it to pass on to the cross connection, the air valve of which limits the pressure to 110 lb. In most cases, especially in freight trains which are never coupled taut, the high pressure cylinders alone suffice for starting.



General View of the Brotan Boiler Showing Arrangement of Water Tubes and Drums

The rear stuffing boxes of the piston rods are fitted with metal packing; the piston rods of the high pressure cylinders do not extend through, while the low pressure piston rods extend through at the forward end and run in enclosed guides. In the first two locomotives built, two large air-suction valves were fitted in the steam supply pipes while in the later ones they were mounted on the steam chest. All cylinder heads have safety valves to guard against excessive pressure.

Reversing is accomplished by a threaded spindle operating on a main shaft located to the rear of the high pressure cylinders; from this shaft tie rods on each side connect with the valve operating rod of the low pressure cylinders as the firebox interferes with running this rod continuously as is usually the case. The tie rod connects from the center with the valve operating rod of the high pressure cylinders in such a way that it is free to follow the movements of the truck.

The adjustable screw coupling between the locomotive and the tender is designed for a pull of 23 tons as required by the standard specifications.

Forming part of the equipment is the automatic Westinghouse emergency brake and the non-automatic Henry brake, with a braking power equal to 69.6 per cent of the weight on drivers; a speedometer for a maximum speed of 37 m.p.h.; a sander operated by compressed air which takes sand from a large sand box and throws it in front of each front driver. In addition to this a small sand box, attached to the cab, is provided for the driving wheels of the rear truck. The forward part of the frame is arranged for fitting a snow plow.

The cab has sliding windows at the sides, a ventilating hood and an acetylene ceiling lamp. Each header on the boiler is equipped with a water gage; gage cocks are not provided.

The tender has four wheel trucks which are equipped with the same brakes as the locomotive.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

H. P. cylinders, diameter	20.47 in.
L. P. cylinders, diameter	33.46 in.
Stroke	25.98 in.
H. P. piston valves, diameter	9.84 in.
L. P. piston valves, diameter	13.39 in.
Weights in working order:	
On drivers	214,000 lb.
On front truck	27,000 lb.
Total engine	241,000 lb.
Tender	126,000 lb.
Wheel bases:	
Driving	27 ft. 8⅝ in.
Rigid	11 ft. 1⅜ in.
Total engine	39 ft. 0⅓ in.
Total engine and tender	63 ft. 0 in.
Wheels, diameter outside tires:	
Driving	56.69 in.
Front truck	37.40 in.
Boiler:	
Steam pressure	220 lb.
Diameter, first ring, inside	68.9 in.
Firebox, length and width	122 in. by 79½ in.
Tubes, number and diameter	180—2 1/16 in.
Flues, number and diameter	36—5¼ in.
Water tubes	70—3¾ in.
Length over tube sheets	18 ft.—6¾ in.
Grate area	54.7 sq. ft.
Heating surfaces:	
Firebox and water tubes	247 sq. ft.
Tubes and flues	2,671 sq. ft.
Total evaporative	2,918 sq. ft.
Superheating	857 sq. ft.
Comb. evaporative and superheating	3,775 sq. ft.
Tender:	
Water capacity	6,800 gal.
Fuel capacity	8.8 tons
Rated tractive force, 75 per cent	61,500 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	3.48
Total weight engine ÷ comb. heating surface	63.9
Boiler proportions:	
Tractive force ÷ comb. heating surface	16.3
Tractive force × dia. drivers ÷ comb. heating surface	9.45
Firebox heating surface, per cent of evap. heating surface	9.3
Superheat. surface, per cent of evap. heating surface	32.0

Traveling Engineers' Association Meets at Chicago

President Howley Stated That Co-operation Between the Executives and the Association Was Necessary to Secure Definite Results

DURING the opening session of the thirty-second annual convention of the Traveling Engineers' Association which was held September 16 to 19 inclusive, at the Hotel Sherman, Chicago, considerable stress was laid on the importance of those attending the sessions to wholeheartedly enter into the discussion of the various papers as they were presented. It was further pointed out that the exchange of ideas means progress in any line of endeavor and that it is particularly needed by the members of this association because of the rapid changes in locomotive construction. Each member attending the sessions should at least take home one new idea.

The convention closed with the election of the following officers for the ensuing year: President, W. J. Fee, Canadian National; first vice-president, J. N. Clark, Southern Pacific; second vice-president, J. E. Hurley, Wabash; third vice-president, J. D. Heyburn, St. Louis-San Francisco; fourth vice-president, James Fahey, Nickle Plate; fifth vice-president, Ralph Hammond, New York, New Haven & Hartford. David Meadows, Michigan Central, was re-elected treasurer, and the following were elected new members of the executive committee: A. N. Boyd, Canadian National; G. C. Jones, Atlantic Coast Line; H. B. Kelley, Pittsburgh & Lake Erie; Robert Collett, St. Louis-San Francisco; H. H. Wilson, Baltimore & Ohio, and C. J. Evans, Missouri-Kansas-Texas.

The program was arranged to cover the following subjects: Locomotive Boosters; The Stoker Fired Locomotive and the Future Engineman; How to Improve Oil-Burning on Locomotives; Lubrication and Its Effect on Locomotive Service; Conservation of Locomotive Fuel; Handling Passenger and Freight Trains; The Work of the Traveling Engineer, and Automatic Train Control. The principal addresses were given by R. S. Parsons, vice-president of the Erie; A. G. Pack, chief of the Bureau of Locomotive Inspection, and President Howley. Brief addresses were also made by G. A. Kell (Canadian National) and C. M. Kidd (Virginian), president of the Air Brake Association. Abstracts of Mr. Pack's and President Howley's addresses and some of the more important reports and papers are given in the succeeding columns.

T. F. Howley (Erie)
President

W. J. Fee (Grand Trunk)
First Vice-President

J. N. Clark (Southern Pacific)
Second Vice-President

Address by President Howley

In his address at the opening session, the president, T. F. Howley (Erie), spoke in part as follows:

It is particularly gratifying to me and the other officers of the association to note the large attendance of our membership. This tends to signify your interest in the personal benefits that are to be derived by each one of us through the papers to be presented, the discussions that will follow and the opportunity afforded, through the intermingling of men, all engaged in the same line of business, to learn how other railroads handle problems such as may perhaps be now confronting you.

It also seems to indicate an interest in this association on the part of the higher officers of the railroads we represent, as is evidenced by their granting us permission to attend this meeting and an apparent belief on their part that our work in the duties assigned to us is going to be improved thereby and the results attained in locomotive service are going to be bettered through such attendance. This is something our association can well be proud of as it bespeaks that co-operation between officers so necessary to secure concrete results.

Changes in Locomotive Construction

Constant changes being made in locomotive construction, including equipment and improved methods of operation require the traveling engineer to be constantly on the alert in order to keep abreast of the times, and probably in no other way can this be better accomplished than through the annual meetings and interchange of views as carried by this association, composed as it is of the traveling engineers of almost every railroad in the country.

The motto of our association, "To improve locomotive service on American railroads," backed up by 31 years of earnest endeavor to keep our members up to date in relation to the latest changes in locomotive construction, appliances, improved methods of firing, best methods of handling on the part of enginemen with a view of securing greatest economy in performance and increased safety in operation, cannot well help but appeal to the higher officer who is en-

deavoring to obtain the best results on the railroad which he is assisting to operate.

It is the aim of this association as you know, to present at each meeting a number of papers dealing with the latest information obtainable, both in connection with locomotive features in use for years past and also in regard to newly brought out devices and methods intended to improve locomotive operation. Thus from time to time we have papers having reference to such old time devices as lubricators and injectors tending to keep us up to date in connection with improvements in such devices, papers dealing with breakdowns of locomotive machinery and failures of various appliances and the most practical ways of overcoming them, papers on safety devices, examinations of enginemen and firemen and papers dealing with such new devices as the booster, feed water heater, boiler syphon, etc.

Value of Discussion

In order that each one of us may gain as much useful knowledge during our present sessions as is possible, make a wholehearted effort to discuss each paper thoroughly here in the open meeting where the committee presenting it will have the opportunity to tell you how and why they reached their conclusions. Give us the benefit of your individual knowledge and experience as other members will give you the benefit of their experience. Then we can each of us return to our homes feeling that the improvement we can show in our work through better understanding and more complete knowledge will not only justify to our superiors the expense involved in our attendance at this meeting but will assist in strengthening in their minds the belief that it is to the interest of every railroad to send its traveling engineers to these conventions if they would keep them informed as to the latest developments in connection with locomotive equipments and operation.

J. B. Hurley (Wabash)
Third Vice-President

J. D. Heyburn (Frisco)
Fourth Vice-President

W. O. Thompson (N. Y. C.)
Secretary

Locomotive Maintenance

By A. G. Pack

Chief of the Bureau of Locomotive Inspection

The railroads have become as necessary to society as are the veins that carry the life blood to the various parts of the body. They distribute the commerce of the nation to the points where it can serve the most useful purpose. The locomotive is the heart of transportation and serves the same function for the railroads as the heart does for the body. Unless the heart acts efficiently the blood ceases to circulate freely and the limbs become paralyzed; unless the locomotive is maintained in a high state of efficiency, the arteries of transportation clog and business becomes stagnant and confused.

In considering the subject of locomotive maintenance, I do not come before you with new and untried theories. Everyone of you know what should be done, therefore, it generally becomes a question of doing or not doing that which you know should be done. The question arising is, "are you permitted by those in authority over you always to do the things that you know ought to be done at the proper time and place?" The Locomotive Inspection Law has placed upon every common carrier by railroad, a solemn duty, viz., to so construct, equip, and maintain their locomotives that they may be operated without unnecessary peril to life or limb; and has placed upon you, as employees of such carrier, the same solemn duty. It has given you an authority which cannot be properly evaded, and one which if taken advantage of will help you in having the things done that your training and experience has taught you should be done.

Enginemen, Like Other Workmen, Need Good Tools

The duties of locomotive enginemen are among the most hazardous and exacting. If they are successfully to perform the duties to which they are assigned, they must be active and alert during every minute and every second from the time they take charge of the locomotive at the terminal until they are relieved at their destination. Locomotive enginemen are the one class of people who cannot afford to make mistakes or allow their memories to lapse; they too often pay the penalty with their lives, and the lives of those intrusted to their care. If the engineman is not provided with a machine, in other words, tools, in good condition capable of performing the work expected, it may not be expected that he can keep his mind concentrated on his many duties, and at the same time operate his locomotive to the best advantage.

The Significance of Engine Failures

The many complex appurtenances and appliances which have been added in more recent years to make the locomotive more efficient and capable, require constant care if they are to be maintained in condition to serve the desired purpose. When minor or running repairs are neglected, it adds to the burden of operation and leads to engine failures, breakdowns and train delays. Every engine failure—so called—while on the line of road carries with it the potential of a serious and probably fatal acident. I have never found anyone who could estimate the cost of the average engine failure.

Interfere With Dispatching

Engine failures upset the prearranged plans of the train dispatchers, cause serious confusion on operating divisions, and have been known, in many instances, to lead to some of the most disastrous and costly wrecks. Many engine failures are caused by the failure to make repairs to defects of the most trivial nature. It has been charged, not however in general, that the defects to which federal inspectors take exceptions are of a trivial nature and that the repairs to such defects are trivial, with which I agree; but, when the failure of parts and appliances of the locomotive and tender cause injury and death and the serious loss of property, of which we have many records, it cannot be considered as a trivial matter. The proper time and place to make repairs is at the terminal and before locomotives are offered for service. It is better, viewed from any angle, to have trains delayed at the terminal than it is to have engine failures, break-downs, and serious accidents while on the road.

The Importance of Adequate Facilities

In considering locomotive maintenance, the subject naturally divides itself into two parts—classified repairs and roundhouse repairs. The backshop is the place where the heavier repairs should be made. The roundhouse is the place where the lighter or current running repairs should be made. When classified repairs are made in roundhouses or when running repairs are made in back-shops, the logical order of things is violated and consequently, unsatisfactory and inefficient results are obtained. It is not uncommon to find large portions of roundhouses blocked with locomotives undergoing classified repairs which could be more promptly and economically made in the backshops, while locomotives which should receive terminal attention in the roundhouse are being repaired on the outside without facilities and where men are compelled to work under the most adverse conditions, exposed to the elements. It goes without saying that such methods tend toward improper repairs and higher cost of maintenance with extremely unsatisfactory results.

Some carriers have given a great deal of attention to shop and enginehouse facilities and to providing modern tools and machinery for dismantling, repairing, and assembling locomotives, until today we have many examples exemplifying the highest state of the art. These should be given earnest consideration by carriers that have not kept pace with the changed operating conditions and in providing and maintaining adequate shop and enginehouse facilities. Inadequate shop facilities and poor organization mean failure to make the best use of our resources; they mean higher labor cost and the added cost which results from holding locomotives out of revenue service, with the necessity for a greater number of locomotives to handle a given business. Terminal and shop facilities are potent dividend producers or reducers in proportion to the methods pursued and the efficiency of organization.

Make Repairs Currently

It seems hardly necessary to urge the importance of making proper inspections and proper repairs currently, because the results of failure to do this are too well known and because it is to the interest of everyone connected with the operation of railroads to have these things done. Nevertheless, during the past 13 years federal inspectors have been compelled to order withheld from service 48,836 locomotives because of defects which unnecessarily increased the peril of operation and decreased the efficiency of the locomotive. Practically all of this number had been pronounced ready for service or were actually in service with defects constituting violation of the statute and of economic law.

Comparing engine failures, one road with another, is of little value because no standard has been fixed. There is, however, no better index as to the condition of locomotives than an accurate comparison of engine failures on a given road.

This was very forcibly brought to my attention about a year ago on one particular line where we were encountering considerable difficulty in having the requirements of the law complied with. A vice-president went so far as to request that the federal inspector in that district be removed to some other district because of alleged prejudice. This vice-president requested a conference with me at which the superintendent of motive power was present, when the conditions to which exceptions had been taken were discussed in their various details. The conclusion was reached by this same vice-president, that he wanted the inspector about whom complaint had been made to stay on his line and wished that he had more inspectors on his line because they were developing and putting before the management the conditions that cause engine failures, train delays, accidents and injuries. What has been the result? During one year there were about 400 engine failures per month with an average of 3,545 miles per failure. A year later the number of engine failures per month had been reduced to about 90 and the miles per engine failure had been increased to about 15,000. This is a vivid contrast between proper and improper inspection and repair. Proper maintenance of locomotives increases the earning power of any railroad, while improper maintenance reflects itself indirectly in unnecessary expenditure.

Factors in Good Boiler Service

No locomotive is better than its boiler. Marked advances have been made in the design and construction of locomotive boilers, while the original principle is still retained, tending toward better circulation of water and better distribution of expansion strains. No matter how well constructed a boiler may be, it cannot be safely or efficiently operated without current inspections, tests, and repairs. No one disputes this but it is surprising to learn the large number of locomotives upon which defects have been reported trip after trip and day after day and still continued in service without regard to the peril created or the monetary loss indirectly incurred.

One of the first considerations in maintaining boilers is that of water supply. Those of you who are connected with the operation of locomotives in bad water districts know of the problems arising from this source, both from the maintenance view-point, and of getting over the road with a train. Too much cannot be said for the necessity of removing all washout plugs and thoroughly washing all parts of the boiler as often as water conditions require. It is too often true that boiler washing is neglected, which is always reflected by increased trouble and cost of maintenance. When sheets are coated with scale, thus insulating them from the water, the water cannot absorb the heat readily and the result is increased temperature and strain with a corresponding increase in trouble and decrease in evaporation.

Marked improvements in water supply have been made in many places by the installation of treating plants and in others by changing the source of supply. Conditions have been vastly improved, in many instances, by installing modern washout systems. These improvements cost money, but when one considers the reliability and efficiency of service that is today required of locomotives, it becomes apparent that any reasonable expenditure in providing better water and proper washing facilities is ultimately a paying proposition. There is a close and inseparable relation between locomotive maintenance and fuel economy. The increased cost of fuel has made it a matter of prime importance and is attracting the widest attention among the railroad managements at this time.

Efficiency and economy of operation has caused the application of brick arches, superheaters, combustion chambers, feed water heaters, thermic syphons, and many other appliances, which must be properly maintained if the desired

results are to be accomplished. Since steam is the propelling power the problem to generate it freely and to use it economically is an all important question. To this end locomotives should be so maintained that the distribution of the steam to the cylinders be most effective, and that the machinery be in condition to utilize the energy created to the highest possible degree. Rod bearings which are loose and in bad condition, boxes loose on journals, shoes and wedges out of adjustment, loose and worn cylinder packings which blow, valves out of square and blowing, are poor mediums through which to transmit the energy; they adversely affect the drawbar pull and the earning power of the locomotive.

The Monthly Budget Not a Promoter of Stability

One of the unfortunate situations confronting the mechanical departments is the manner in which their appropriations are made. It is my thought that an annual, instead of a monthly, budget or allotment should be made. One of the most important considerations in the matter of locomotive maintenance is to have a corps of competent, steady, reliable, and contented employees. We must have contentment if the best results are to be obtained; discord and confusion among employees is not conducive of the best results. Discontentment and confusion are bound to ensue when employment is uncertain and irregular.

There is nothing which so adversely affects economy of locomotive maintenance as to tear the mechanical organization to pieces each month or at frequent intervals in order to keep within the appropriation or to fluctuate the personnel with every temporary traffic change. I appreciate that revenues can not be disregarded when making expenditures, but, with proper consideration, forethought and foresight, expenditures can be anticipated with sufficient accuracy and the mechanical forces so regulated as to provide steady employment. Steady employment at remunerative wages brings about a satisfaction among employees that is hard to disrupt; on the other hand, when men are treated as machines and laid aside without regard to consequences, and without sound reason, it breeds bolshevism, unrest and disloyalty, and brings hardships, not only upon the men thrown out of employment, but upon everyone connected with the organization.

Again, locomotives cannot be properly and economically maintained if repairs are neglected until the rush period is on. It is then that the locomotives should be in revenue service and not in the shop; it is then that the transportation department is pressing for motive power. Therefore, in keeping with sound management the locomotives should be repaired in the dull period and be available in a high state of repair when the rush comes, if traffic is to be most efficiently and economically handled.

Locomotive Boosters

The demand for efficiency and economy in locomotive design and service is increasing every day. Every new idea that can be worked out successfully along those lines is speedily accepted by railroad managements. Consequently when the booster idea was conceived and grew into a working model and a very successful one, it has met with most gratifying success in a short time, being used first on the New York Central in 1919.

The greatest difficulty in handling a maximum tonnage train is in getting it started as well as getting it over the grades. It is a well-known fact that the tractive effort necessary to start a train is far greater than the effort required to keep the same train in motion. It is also true that the horsepower the locomotive develops is greater while in motion than when starting from rest.

For many years enginemen have worked on this principle without success, until in 1918 H. L. Ingersoll, assistant to the president of the New York Central, developed the booster and brought it to its present high standard of efficiency. It is now considered a necessary appliance and has been placed on over 1450 locomotives on 43 different railroads in the United States and Canada, and applications have been made on locomotives on several foreign roads.

The locomotive booster is a horizontal two-cylinder double-acting steam engine mounted on the trailer truck and connected directly to the trailer axle of the locomotive through suitable gearing by which it may be engaged or disengaged at will.

It is designed for applying power to the trailer wheel in the *forward motion only*. It cannot be operated when the engine is in back motion.

It is self-contained and has a flexible mounting in the form of a three-point suspension. Bearing on the trailer axle are two of the points, while the third is the spherical seat at the center of the rear cross member of the truck frame, which latter allows free movement of the booster with the varying positions of the trailer axle.

The engine is a very simple type, consisting of two 10-in. by 12-in. cylinders with piston valves taking steam direct from the dome or from the steam chest. Steam is admitted to the cylinders three-quarters of its stroke and has no variations in cut-off.

Steam admission is controlled automatically at the will of the engineer. Exhaust steam passes through flexible connections from the booster engine to the atmosphere through the exhaust nozzle and stack.

The machinery of the booster consists of a crank-shaft driven by the booster engine which in turn drives the idle gear so placed as to mesh with another gear on the trailer axle, by means of the automatic air-operated clutch, driving the trailer axle, thereby making a temporary driving axle to assist the main driving axles in starting or exerting increased effort as needed.

When the train reaches a speed of about twelve miles per hour, the idler gear is automatically released by the reverse lever which is pulled back to reach a pre-determined point so it disengages the latch of the pilot valve, or the engineer can disengage it by knocking down the booster latch. The booster then is inoperative, in which condition it exerts no power, but is available when extra power is needed.

The purpose of the booster is to provide additional starting effort, increased power for acceleration and additional tractive effort on grades.

It can be attached to the trailer truck of the locomotives and is a reserve power that can be quickly applied when needed and as quickly released when not needed.

It can be used in starting trains and its power utilized until they reach a speed of twenty miles an hour, when it should be disengaged.

The starting power of the locomotive is governed by the weight carried on the drivers. The trailer axle usually carries as much weight as one pair of driving wheels. Various ways have been devised to utilize this idle weight of the trailer wheels and axle and divert them into driving wheels.

This is where Mr. Ingersoll's idea has been successfully developed. He realized that to apply his idea correctly certain limitations and functions must be considered, such as the minimum amount of changes to be made on existing locomotives, not disturbing the relation between the fire-box trailer axle and the diameter of the trailing wheel, installation of the power units so that it would deliver the torque to the trailer axle without in any way affecting the action of the rear end of the locomotive, obtaining additional power only at starting and low speeds, when the boiler can supply more steam than the main engine can utilize, that the power unit should normally be controlled by the engineer but should be inoperative automatically after the locomotive has attained a pre-determined speed, and that there should be

no interference with the functioning of the locomotive at high speed.

The booster is an advantage in both passenger and freight service, as an aid to smoother starting and quicker acceleration which results in greater comfort to passengers, as an assistance of sufficient power to start trains under adverse circumstances and increased tonnage, it avoids taking the slack in starting trains, resulting in reduced cost of equipment maintenance, and also in many cases the use of expensive helper service is eliminated. It increases the ton miles per hour per locomotive over a division.

It is of equal importance in hump and transfer service, as it assists in starting trains with less damage to equipment. Tests in yard service show there was an increase of about 15 per cent more cars handled per engine than by the same class of engine without a booster. In the ability to add increasing starting and accelerating power to existing locomotives lies the hope of lower transportation costs through more tonnage haul per unit.

Boosters now in service show an addition in starting power to the Santa Fe type of 10 per cent, the Mikado type of 23 per cent, the Pacific type of 27 per cent, and the Atlantic type of 36 per cent.

The effect of the booster on the locomotive is merely an increase of 5 per cent in static stresses, which is well within the allowance in specifications for bridges, buildings and other mechanical construction.

The increased power has decreased by almost one-half the time required to get trains to road speed. By providing the extra power needed to give a smooth, steady start, the booster locomotives avoid the necessity of taking slack, thus reducing draft gear maintenance, which is one of the largest items of freight car repairs.

The operating results that are being secured by a booster equipped Mikado over the 100 per cent tonnage rating of 23 Mikados which are not booster equipped, is as follows:

Increased tonnage ....tons	392
Ton-miles per day....	39,200
Ton-miles per 100 miles for 30 days....	1,176,000
Additional monthly earnings, $.0007 per ton-mile....	$8,232
Additional freight, one way only....	$4,116
For one year (300 days in service)....	$41,160
Revenue ton-miles compared with total ton-miles......per cent	67
Actual increased earnings....	$27,577

The report was signed by W. H. Corbett, (M. C.), chairman; J. A. Talty, (Franklin Railway Supply Company); H. L. Symons, (D. & H.), P. H. Ryan, (I. C.), F. W. Stoll (N. Y. C.), and W. B. Smith (B. & A.).

Discussion

Practically all the members who discussed this paper indicated a favorable opinion of locomotive boosters in view of their performance to date. One of the members said that they enable the tonnage rating of freight locomotives on his road to be increased 300 tons, another member said 500 tons and still another, 1,700 tons. Presumably the difference is accountable for by local conditions and gradients on the different roads. The favorable effect of the booster in enabling passenger locomotives to start heavy trains of steel cars without taking slack was pointed out. The consensus of opinion seemed to be that the best results are secured when the booster is piped to operate on superheated rather than saturated steam and when one man is regularly assigned to care for the boosters at the enginehouse and see that they are properly oiled and maintained. The records show that approximately one quart of car oil a month and one-half to three-quarters of a pint of valve oil are used, provided there are no leaks.

James Fahey, (N. C. & St. L.) said that boosters have been tested, using a dynamometer car over a period of one year and seven months, and, in view of the satisfactory results achieved, they are now being applied to heavy power, three at a time at the enginehouses without waiting for the locomotives to go to the back shop for heavy repairs. Mr. Fahey also testified that the boosters are responsible for reduced fuel consumption, that little difficulty is encountered due to maintenance, and that in the winter trains have been found frozen, but with the boosters still operative.

While one member said that in his experience the operation of the booster for six minutes would cause a reduction in steam pressure, other testimony was to the effect that the boosters have operated in certain cases as long as one hour and seventeen minutes on a grade without causing a material reduction in steam pressure.

The only criticism developed regarding the booster was the necessity of keeping the various air pipes absolutely tight in order to keep the booster operative. One member also said that he had had a broken main rod and loose crank pins which necessitated the removal of the boosters from the trucks and required considerable work before the necessary repairs could be made. Other members on the other hand claimed to have had almost no difficulty due to the maintenance of the boosters and in one case the only work needed after 45,000 miles of service was to re-pack the piston rods.

It was pointed out that in freight service the booster should be cut in when speeds fall to 10 miles per hour in order to get the best results rather than allow the speed to get too low. In passenger service, one member said that the booster should not be cut out until a speed of from 15 to 20 miles an hour is attained as in this case the utmost advantage is taken of the booster to secure rapid acceleration. Like all other locomotive devices, the boosters can be misused and abused by enginemen who do not understand them. The advisability of getting a little sand on the track before starting the booster was brought out in the discussion. The cost of a booster applied was said to be $7,500, an amount quickly repaid by the increased earning power of the locomotive.

Stoker Fired Locomotives and the Future Engineman

The modern locomotive and the present-day train cannot be handled successfully by skill and instinct only. In addition it requires rare judgment, thought and resourcefulness. This can only be obtained through the exercise of the mental faculties, and as the exercise of the mental faculty presupposes a mind or brain, we get right back to the first proposition, that it takes brains to run a locomotive. And thus we have as the first part of our problem the fact that the engineer, to be an engineer, must have a good active brain.

The next part of our problem is: Where will we get this man? It is becoming more and more difficult to obtain the right kind of men from whom we must draw to get the future engineman. As our only source of supply is from the left side of the engine, it follows that the fireman must have brains or he cannot become an engineman.

Granted that we set out to employ a man who can think. We place him on a large hand-fired engine to learn the art of firing. When he looks back he sees from 16 to 20 tons of coal staring him in the face. On the deck he sees a large scoop, a coal pick and a clinker hook. He turns around and sees a fire-door which, when opened, pours out a stream of heat that will burn his overalls off if he gets too close, and near the door a shaker bar and a bunch of shaker levers. He is told that all he has to do is to crack the coal, throw it into the firebox, and then shake down the ashes.

He looks all around and sees men employed in gainful occupations and has a fairly accurate idea of what their wages are. He sees men building a house and visions the time when each of these, the carpenter, the bricklayer, etc., can, by proper application, become contractors. In fact, every place he looks he sees possibilities of promotion, until he looks at the fireman and then he begins to figure: "Let

me see—I am twenty-one now; if promotion continues as slow as at present, I will be nearly forty before I am promoted. I wonder if the romance of the calling won't be somewhat worn off by that time—I wonder."

To hold this man on the job, we must try to get back to the old system as near as possible. True, we cannot hurry promotion; neither can we go back to the small engines, nor can we (even if we so desired) stop the march of industrial progress in those other directions that hold out possibilities to the young American, but we can make the fireman's work more attractive by making it easier. We can fire locomotives mechanically and thus relieve him of the hard manual labor and give him time to think and study to fit himself for the position he aspires to.

Do you think if a student fireman who has decided to take up railroading as a lifework, gets on a stoker-fired engine, he will quit the job after one round trip? If you do, you are not familiar with human nature. On the contrary, he will become so interested that he will not be satisfied until he masters the machine, and by that time he will see that there are other possibilities ahead of him in railroading besides running an engine, if he only applies himself; but when a man is worn out physically you can't expect much from him mentally, and the thinking man realizes this and gets off.

Going back to the beginning—if we want to maintain the high standard of enginemen that we have at present and that the service demands, we must begin with the fireman. Of course, we appreciate the fact that on all railroads there will always be hand-fired engines. The thinking man will realize this also, and so long as these engines are within the capacity of the fireman he will not let that stand in the way of his accepting service, as he can see that after his term on the hand-fired engine has been served he will get a stoker-fired engine, a job that aside from the pay is nearly as good as one on the right side. And the ultimate effect will be that the present high standard of enginemen, of which we are all justly proud, can and will be maintained, and the railroads will derive benefits through better train and engine handling far in excess of the financial outlay.

Your committee for a number of years has watched the evolution of the mechanical stoker and its increased efficient operation by the fireman. We also have noticed the increased knowledge pertaining to locomotive operation that the regular assigned stoker fireman has absorbed. In the past when we had all hand-fired engines if you asked a fireman how much coal he used on the trip, he would usually answer: "Oh, I don't know—about two tanks full." Nowadays it is different. On the road with which your chairman has the good fortune to be connected it is not unusual to get up on our stoker engines and ask the fireman: "How is the fuel consumption showing up on this engine?" He will answer right off: "Oh, about so many pounds per 1,000 gross ton-miles or per passenger car-mile." And that is not all. He will tell you whether or not the evaporation of water per pound of coal is what it should be and a good many other things that he did not know while on the hand-fired engine. He will talk to you about the air openings in the ash-pan, and why he has to carry a lighter fire on one engine and a shade heavier on another.

Now why can this fireman talk so intelligently about locomotive operation? Because with the stoker-equipped engine he has time to think and study. Let me give you one example of a fireman who had learned to think. Your chairman was operating a locomotive with 100 tons over the rated tonnage of the locomotive. In order to make a meeting point for four passenger trains, he said to the fireman: "We will run this next water station and go to K. for water." He said: "That's good, and we will have about ten inches of water in the tank when we get there." As this fireman had not looked into the tank since last taking water, I wondered how he knew just how much water would be in the tank on arrival at K. (this being an unusual run he had never before made with such a heavy train). In conversation with him he explained why he could tell without looking into the tank. He stated that he knew from the uniform maximum steam pressure, the very light fuel consumption and the quarter turn of the water valve to injector that the engine was not using much water.

The mechanically fired locomotive is quite a factor in educating the fireman not only in the economical firing of the engine, but also enables him to better observe the manner in which the engineer handles the engine. Another fact is that the stoker has a tendency to make the fireman more mechanical. He feels there is a certain amount of responsibility attached to the operation of the stoker. Therefore he gives more attention and thought to the locomotive as a whole than when on the hand-fired engine.

From a safety standpoint the mechanically fired locomotive has the advantage of two men being constantly on the lookout. Inquiry of one railroad brought out the fact that there was no record of any mechanically fired locomotive running by a block or red board. This in itself is of more value than appears on the face. One bad rear end collision will pay for any number of stokers.

The mechanically fired locomotive will in our opinion enable railroads to employ high-class young men for the position of fireman, who in time will become high-class engineers, and in the end the railroads will profit by it with increased tonnage, reduction of number of hours on the line, reduced fuel consumption and less fire-box and boiler maintenance expense. Mechanically fired locomotives make contented jobs for the engine crew, and a contented engine crew is a valuable asset to the railroad.

The report was signed by Jas. Fahey, Nashville, Chattanooga & St. Louis, chairman; F. P. Roesch, Standard Stoker Company; A. N. Wilsie, Locomotive Stoker Company; H. Von Erickson, Great Northern; W. T. Hanna; N. Shurie, and R. Hammond, New York, New Haven & Hartford.

Discussion

The discussion of this paper indicated plainly the opinion of the majority of the members that mechanical firing enables a higher grade of men to be hired for the position of firemen and consequently provides a better source from which to obtain competent enginemen. The fireman on the stoker-fired engine reaches home after a trip in such physical condition that, with sufficient ambition, he can study effectively. In addition while on the locomotive he is enabled to study the engineman's method of handling locomotives much more than formerly. An important safety feature is provided in that the fireman has time to assist in watching for signals to a much greater extent than when compelled to fire locomotives by hand.

In general, mechanical stokers are applied on locomotives of 50,000 lb. tractive effort or greater, which leaves out many of the Pacific type. The safety feature, however, may in some cases justify application of stokers to locomotives which as far as size is concerned could be hand-fired effectively.

Oil Burning Improvement on Locomotives

There are now 45 railroads in the United States making use of oil fuel in locomotives to a greater or less extent. Last year these railroads used 57,600,000 barrels of oil valued at approximately $7,800,000.

With this widespread use of oil as fuel on our railroads, not only the most capable officers and employees of the railroads themselves but the best combustion and designing en-

gineers in the world have devoted their best efforts in producing the modern oil-burning locomotive. To say that it is not highly efficient would be to ignore the results of thousands of tests which plainly show that it compares very favorably with the most modern central stations and that it does so under serious handicaps. But none of us is satisfied, nor do we think perfection has been reached.

How to improve the burning of oil in locomotives brings us face to face with the problem of securing complete combustion of a large amount of oil in a small space and during a very limited time. From the time a drop of oil leaves the burner tip until it is completely atomized, consumed and has reached the flue-sheet less than one second has elapsed.

There are four conditions ever present that must be met before complete combustion of oil can take place; first, the oil must be properly atomized; second, we must have the proper amount of air; third, we must have the proper temperature in the fire-box; fourth, we must have a sufficient length of time for the thorough mixing of oxygen and gases and to complete combustion before they reach the flue-sheet.

Burner

That much thought has been given to the construction and design of oil burners is shown by the fact that more than 3,000 burners have been covered by patents in some form or other; yet the few steam atomizing burners in most general use on the largest oil-burning railroads are of simple construction, have stood the test under keen competition, and some of them are now unprotected, as the original patents have long since expired.

Many attempts have been made to introduce mechanical atomizing burners on locomotives, and no one doubts but what a more complete and thoroughly atomized oil spray may be obtained through such a burner, but the chief difficulty encountered is in the range required. A 2-10-2 type locomotive under maximum working conditions consumes 550 gal. or 4,400 lb. of oil an hour. The ordinary mechanical atomizing burner will deliver 300 gal. or 2,400 lb. of oil an hour, which would mean two such burners. The problem therefore appears to be one of increasing the capacity of the mechanical atomizing burner rather than installing more than one burner.

This subject is now receiving careful study at home through a trial installation of a mechanical atomizing burner on a switching locomotive of an eastern railroad. The burner being tested is the wide-range mechanical atomizing type of the Peabody Engineering Corporation. This burner was installed October, 1923, and no difficulties have so far been encountered in maintaining maximum steam pressure; neither is it necessary to clean soot from flues, as the oil is so completely consumed that no soot is deposited.

A very interesting experiment with mechanical atomizing burners on locomotives was conducted recently on one of the large French railroads. These tests were highly satisfactory and they now have 37 locomotives so equipped. One burner is capable of taking care of a French locomotive, but their power is somewhat smaller than ours. This burner is the Whitehead Ray rotary type, an American product. A dependable supply of oil for locomotive use is at present an unsolved problem with the French railroads.

That possibilities exist through application of mechanical atomizing burners for economy in the amount of steam used for atomization (the ordinary steam atomizer-burner uses from 2 per cent to 4 per cent of the total output of steam) and for reducing the amount of fuel that is required by improving combustion, no one doubts, but there are some difficulties yet to be surmounted.

Steam is the spraying agent now in use to atomize oil, although certain people recommend the use of air. If you should experiment with air for atomizing, don't rob the compressor, for 100-car trains are the prevailing style and they keep the air pump fairly busy. From a mechanical point of view a cubic foot of compressed air would break up as much oil as a cubic foot of steam if both were at the same pressure. But taking the mechanical efficiency of the air compressor into account, a cubic foot of compressed air costs nearly twice as much as a cubic foot of steam at the same pressure. What is desired is that oil should be at the highest practicable temperature as close as possible to the burner tip. The use of compressed air as an atomizing agent tends to lower the temperature at the burner tip, while the use of steam as an atomizing agent tends to raise the temperature at the burner tip. It should be noted that this increased temperature is accomplished in two ways: First, by heat transfer due to coming in contact with steam, and, second, by absorbing heat given off by steam during sudden expansion. The dryer the steam used for atomizing the oil the better the results. Superheated steam therefore has the preference.

Burner Location

The standard location of the burner is in the front of the fire-box below the flue-sheet, the oil being sprayed toward the back end of the fire-box, where the flash-wall is located to deflect the flame, which then turns and travels again about the full length of the fire-box to the flue-sheet. This location was adopted after numerous tests with the burner in the back end of the fire-box, also with two burners, one in the front end and one in the back end of the fire-box. Of the mechanical burners mentioned above the one being tested on a switch engine is in the back end of the fire-box, while those on French locomotives are in the front end in the same location as our burners.

If it were possible to reduce the distance between the burner tip and the point of ignition, a much longer time would be allowed to complete combustion, the gases would have more time to give off their heat and the advantage of longer flame travel would be obtained.

Pyrometer tests show that the temperature of hot gases entering the tubes drops to about 1,300 or 1,400 deg. F. within 18 in. after coming in contact with evaporating surfaces, which is about the lowest temperature at which complete combustion takes place. Where combustion is not completed by the time the burning gases enter the tubes it is a known fact that they are chilled below the igniting point and deposit carbon on the tubes in the form of soot.

A series of tests were made in the fall of 1919 and the present standard of front end burner without an arch or arch tubes was found to be the best arrangement and produced the highest efficiency.

During the past few months a test has been in progress with thermic syphons on 2-10-2 type locomotives with front end burners to determine if any economies are possible from their use, and since these syphons are in the same relative position as arches or arch tubes it revives interest in the subject and makes one wonder if there would not be a possible field for some economy from further tests with arches in view of the fact they are part of the standard equipment on coal-burning locomotives. Three factors were against the use of arches in the tests previously conducted, namely difficulty in connection with maintenance of arch and arch tubes and the expense and trouble caused by pieces of broken brick falling down in the path of the flame, sometimes causing engine failures, difficulty in sanding flues, especially the lower ones which were behind the arch, and the impingement of flame against the crown-sheet where the arch ended. With the advent of larger power and combustion chambers in fire-boxes we are confronted with somewhat different conditions. Have not the arches been improved through stronger construction and the use of better brick and other material? Will not the mechanical steam soot blower enable us to reach all the flues? The third feature of impingement

is not so easy to overcome and may prove the stumbling block, although improvements in combustion through the mechanical burner may help out in some measure.

Air Openings

The proper location and the correct size of air openings in the fire-pan are of utmost importance. A safe rule is for air openings to be seven times the area of the cylinder. Sufficient air should be admitted around the burner to prevent it from becoming overheated. Too much air admitted around or under the burner unless proper damper control is provided may result in chilling the lower flues, as the air takes the line of least resistance and goes up the front brick wall and into these flues on its way to the stack. Leaky flues are often the result.

Admitting the major portion of air to the fire-box through a flash-hole varying in size from 8 in. by 10 in. to 13 in. by 20 in. and located from 9 in. to 18 in. in front of the flash-wall and a 2-in. by 35-in. opening in the hooded fire-door is one practice on Southern Pacific Lines. The air openings are approximately as follows: Flash-hole 25 per cent, burner openings, 5 per cent, door damper 5 per cent of the minimum area of tubes allowing for units. This is what is known as the vertical draft having the hooded door as against a solid door with a 5-in. circular opening used in sanding flues.

The horizontal draft differs slightly in that it admits the air through small openings in the front of fire-pan around the burner and through the hooded door. Each of these methods are in general use on the Southern Pacific.

The draft-pan opening or flash-hole is also used by other oil-burning roads, but they also have a number of round openings along the side of the fire-pan over which an adjustable slide may be drawn by lever control from the cab to regulate the amount of air.

It is well known that an appreciable amount of heat is lost through radiation from the outside of the boiler, losses being greatest from the outside side-sheets of the fire-box. Engineers today are recognizing the fact that pre-heating the air means fuel economy. It may be possible to use at least part of the heat now lost through radiation for pre-heating air to the fire-box. How this can be done is a matter for development, possibly through the use of easily removable ventilating air ducts attached to the outside of the boiler, conveying the heated air to the present air intakes to the fire-box.

Dampers

The device which regulates the amount of air entering the fire-box plays no small part in maintenance cost and fuel economy. The usual damper control is by rod or chain connection from the cab. On the French locomotives mentioned above a worm gear control on the rod connection from the cab is now in use and gives very accurate adjustment of the damper.

At the present time there are two styles of balanced dampers being tested on the Southern Pacific, one is a butterfly damper enclosed in an air chute at the front end of the fire-pan and the other is a flapper damper which hangs in closed position over the front end of the fire-pan and is opened by draft when the engine is exhausting. Both are meeting with success, but neither has been in use long enough to pass judgment as to which is better.

The dampers on an oil-burning locomotive are in a location where inspection and maintenance are difficult, which should lead us to perfect a damper which will require the minimum of attention and yet be always serviceable.

Furnace Design

Heating surface of the fire-box is worth five times as much per square foot for evaporative purposes as that of the tubes.

Anthracite coal is burned on the grate. As air is passed through the bed of coal the oxygen and carbon unite, mechanically forming complete combustion within the bed of coals. With bituminous coal the oxygen unites with the fixed carbon as with anthracite coal, forming complete combustion within the bed of coals, but the volatile part of the coal is driven off and must find its oxygen and sufficient temperature to complete combustion in the furnace space above the bed of coals. For practical purposes fuel oil is a 100 per cent volatile coal, because the entire body of oil is sprayed and burned in the furnace space. From the above it is apparent that the greater the percentage of volatile matter the greater the furnace volume required. Therefore fuel oil or gas requires greater furnace volume than any other kind of fuel. When coal is burned the radiant heat from the bed of coals ignites the gases over the bed of coals. With fuel oil there is no bed of coals, therefore sufficient refractory surface must be installed in the fire-box to take the place of the bed of coals and furnish sufficient radiant heat to maintain temperatures high enough to complete combustion. Where there is not sufficient refractory surfaces or where the refractory surface is poorly located, drumming will result.

Some oil-burning authorities never sacrifice a square foot of heating surface in the fire-box wherever possible to secure it, whereas the supporters of carrying the refractory high on the side-sheets claim that the heating surface closely adjacent to the mud-ring is of little value. One thing is certain by the new arrangement, and that is, that engines will not be in the back shop as often by far for new side-sheets with the high refractory setting.

Front End

There has been considerable speculation as to the removal of baffle-plates from superheated locomotives using oil as fuel. One road reports no apparent deterioration of superheater elements, although the baffle-plates were removed from these oil-burning locomotives two years ago. It is the purpose of these baffle-plates to prevent gases from passing through the superheater flues while the engines are being fired up and standing and also to give a more equal distribution of the gases between the upper and lower portions of the evaporating surface and superheating surface. With the baffle-plates removed the natural tendency is for the gases to flow through the top flues where less restriction is offered. On some of the engines which have had the baffle-plates removed a longer downward extension stack has been applied, which in a measure helps to baffle gases passing through the top flues, creating a condition similar to that where baffle-plates were in use. With baffle-plates removed it is much easier to keep the flues clean, as they take sand more readily. It is also easier to fire up engines without forcing and making black smoke. It also means one less item of maintenance. It is no doubt a fact that the removal of baffle-plates from oil-burning locomotives would be more advantageous and that less damage would occur to the superheater elements than on a coal burner.

The report was signed by J. N. Clark, Southern Pacific.

Discussion

In discussion of the paper on oil burning, one member said that he had tried eight different types of burners and that only 5 per cent difference in fuel consumption between the best and the poorest could be discerned. This was in a test of 2,400 miles for each burner. The location, method of connection and height of the burner have an important bearing on oil consumption, however. The consensus of opinion was that the burner should be located from five to eight inches above the floor of the fire pan, the prime essential being the placement of the burner so that the flame is directed properly. A space of approximately five feet should be allowed from the burner to the flash wall for the most desirable results.

Waste—Some Ways to Eliminate It*

The Untimely Reduction of Forces and the Lack of Standardization of Car Parts Results in Enormous Losses

By D. M. Raymond
Car Foreman, Union Pacific, Green River, Wyo.

ONE of the most prolific sources of waste in the mechanical department of a railroad comes from a practice which possibly would least be expected to result in waste. This practice is one followed by practically every railroad, that of reducing mechanical forces during times of business depression. In other words, steps taken to reduce payrolls in an effort to cut down expense, while temporarily effecting an apparent saving, actually result in the eventual expenditure of sums exceeding the amount saved.

Admitting that such a statement appears paradoxical at first glance, it is nevertheless founded upon good and firm reasons.

Let us take the situation from the beginning to the end: First, we have the beginning of the business depression; second, will be the reduction of shop forces, including skilled as well as unskilled mechanics; third, comes the resumption of business; fourth, the enlargement of shop forces. These four points are the governing factors. Analyze them one by one and the real result that follows each individual action will become apparent.

The first point, being outside the province of the shop worker, we will pass over, it being admitted by every person even partially familiar with the subject, that business depressions are evils which cannot always be avoided and must, therefore, be accepted as they come and coped with as well as circumstances permit.

Therefore, we shall pass to the second point. In this item we have debits and credits, which, briefly, are as follows:

Credits—Instantaneous reduction of expenditures.

Debits—(Not instantaneous but accruing). They would be listed somewhat on the order following: Rapid deterioration of equipment and eventual storage of bad order rolling stock.

Since it is only in a complete analysis that the debits can be made to show up against the credits, we will have to let such analysis wait for the following two points, in order to get at the real proposition. Therefore, let us go on to the third point which brings about a demand for equipment as well as a demand for immediate increase in shop forces to restore bad order equipment to service, at the same time keeping present rolling stock in condition. Now, we will see just what happens from the beginning to the end.

Since, as stated above, the actual results of the first and second steps are not instantly discernible, but are dependent upon the third and fourth steps, we can make the point clearer by dealing directly with conditions covered by those last two steps.

A demand for equipment develops. Where is it? Mostly on repair tracks and storage tracks. An easy matter to get cars out of storage, we will admit, but when you come right down to the point you will find that they were not placed in storage until some minor defect, if not a major defect, developed to make them unserviceable. They were not repaired for the reason that a shortage of forces made it impossible to repair them, and because there was no urgent need of the cars. Therefore, the situation you have to meet on the resumption of business, is one calling for the hurried repairs to rolling stock. It is a fair guess that shop forces are not going to be recruited to full strength soon enough to meet all the demands for equipment. Therefore, the ensuing losses due to the inability to get cars into revenue service must be placed as a debit against point two.

There is another point to be taken into consideration. It is the fact that in the recruiting of shop forces men are taken on who are not familiar with practices on the road which employs them. What is the result? However skilled a mechanic may be in his craft, he must lose a considerable amount of time in becoming familiar with local routine, his fellow employees, etc. Nevertheless, because he is a skilled mechanic, he is paid full rate. It is apparent that he is wasting valuable time as compared with an employee who is thoroughly familiar with practices. Therefore, we have another debit to place against point two.

Let us assume that instead of laying off a skilled man we keep him on the payroll during the depression. There would be little saving effected at the time when it would seem to be most needed, but let us look farther and see if in the end his retention would not be justified. For one thing, shop forces would have an opportunity to catch up on all bad order equipment. No cars would be sent to storage for the want of repairs. Such repairs could be made first. Then, when the business revival comes, the equipment is there, ready for instant use—no waiting. Furthermore, the shop forces are not rushed off their feet by demands for equipment over-night when there is little hope of getting the equipment in shape to meet demands for some time—perhaps weeks or months. Neither will the shop forces have to lose valuable time in waste motion getting acquainted and becoming accustomed to practices which would be the case as above mentioned. Instead, they would be in a position to augment their roster by taking on men who need not necessarily be skilled and who, accordingly, would not be drawing high wages. This means another direct saving which should be debited against point two.

Still another good feature in keeping the skilled men at work all the time is in the fact that such men as could be made to feel that no depression would necessitate their separation from the payroll, and this would naturally repay the employer in loyalty as well as increasingly effective work. They would feel that they were actually members of the family. Such a morale is highly desirable in any large organization, particularly on a railroad which depends to such a great extent on public opinion.

While a proponent of the force reduction policy might be inclined to question how skilled forces could be maintained the year round, such a question being natural under present conditions, it must nevertheless be borne in mind that it should never be necessary under the retention policy greatly to augment forces when the rush begins.

The logical conclusion is that by striking an average of the number of skilled employees necessary at given points during the whole year and putting that average on duty for the entire year, the number could easily cope with any condition which might be expected to arise, considering that there would not likely be any condition which always comes under the force reduction plan.

Weigh the two arguments together as carefully as you

*This paper was the second prize award in the competition on the elimination of waste which closed November 15, 1923.

wish. No other conclusion can be drawn than that eventually the retention policy will result in more benefits than the reduction policy. Hence, the statement at the beginning of this article, that the greatest waste on railroads comes from laying off mechanics because of business depressions.

There is still another large waste—one which every railroad man has recognized—particularly the car man. It is the limited scope of standardization of freight car parts. No one familiar with the subject will deny that millions of dollars annually are contributed by the railroads of the United States to the scrap heap because of wrong repairs.

Suppose we take into consideration the item of draft gears alone. Certainly there is no single railroad in the country which carries parts of all draft gears in their entirety. In fact, while they may carry a large portion of the present makes of gears, they do so merely in order to facilitate repairs to foreign equipment, not for their own use except insofar as they are benefited in keeping their repair tracks cleared of foreign per diem earning cars.

Yet there is an enormous amount of capital tied up in these stocks kept on hand. And that amount could be reduced by not less than 50 per cent if plans were effected to standardize equipment throughout the country and do away with unnecessary purchasing, handling and storing of material.

The only persons who would be interested in reading this article undoubtedly would be those who are familiar with car parts and car matters. Such persons are already fully aware of the large waste brought about by the lack of standardization of freight car parts. Therefore, any detailed analysis of the situation would be only useless here. It is enough to point out that with freight cars standardized, it would be unnecessary to hold foreign cars on repair tracks for days at a time awaiting material from owners during which interval they are losing revenue, both for the owner and handler. Or, suppose the handling line should make wrong repairs. It comes to the same thing in the end. It is only a waste; for while the road making wrong repairs may get the car moving, it will eventually have to stand the cost of correction of the wrong repairs, and the car sooner or later goes out of service and becomes a drone instead of a worker during the period when it undergoes correction of wrong repairs.

Of course, it is admitted that the present day practice of using so many different types of car parts is due in some respect to the endeavor to bring out in actual test in service that part which is superior to others of the same type. That is the one good feature about the lack of standardization. However, in view of the present day methods of testing parts in laboratories especially designed for such testing, making it unnecessary to put them in actual road service, it is undoubtedly possible to conduct such tests apart from actual road service until such time as the approved parts are eligible for adoption as a standard for all car owners. In this way no deterrent would be placed in the way of inventive genius.

So, in the above, you have two of the largest wastes in the mechanical department of a railroad. The waste on account of reduction of forces without proper insight into the future and the waste on account of lack of scope in the standardization of car parts.

Suppose the two enormous wastes were such that they could be shown in actual dollars and cents—and insofar as those concerning wrong repairs they could be put in figures to some extent—is there any foreman who has a doubt that such a showing of figures would convince the most skeptically inclined that the adoption of the above ideas would result in a prevention of waste running into millions of dollars annually?

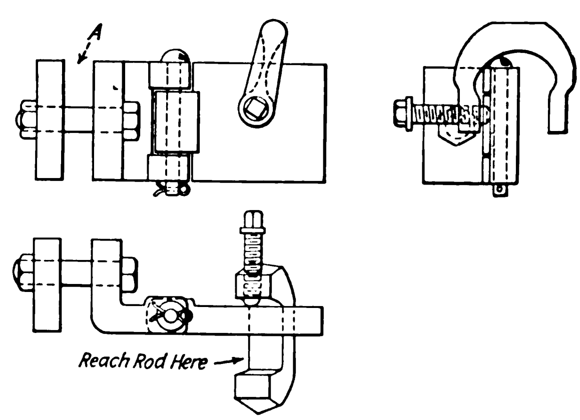
Helpful Suggestions for Setting Valve Gear

Simple Formulas Used to Obtain Correct Alterations for Eccentric Rods and Valve Rods

By H. W. Stowell
Machinist, Santa Fe Shops, Albuquerque, N. M.

In setting valves on locomotives equipped with the power reverse gear it is necessary to take some precaution to prevent creeping. Some of the older types are provided with a set screw on the reversing crosshead which is very convenient for the valve setter. In types not so equipped it is necessary to clamp the reach rod either by a special clamp as shown in the illustration or by some other arrangement. The clamp is bolted at *A* to the screw reverse frame which binds the reach rod tightly against the hinged portion. This allows the angle iron to fit squarely against the reach rod so that it may be tightened securely without springing it.

Where should the reverse lever be set to square an engine by the port openings? In engine house practice the length of the motion rods is usually tested by trailing the locomotive over and scribing the valve stem to show the port openings. The reverse lever is generally placed in or about the working notch to produce a cut off at approximately 25 per cent. There is a certain position for each different kind of valve gear where the best results will be secured. The manufacturers of the Baker valve gear recommend trailing locomotives equipped with the gear in the 25 per cent cut-off position, which produces an average port opening of 7/16-in. If the Baker gear is run over in this manner and then placed in the corner notch, some startling distortions will be observed. With the valve square in the hooked-up position the valve rods and eccentric rods will show out as much as ¼-in. when the lever is placed in the corner notch.



Hinged Angle Iron for Clamping Reach Rod When Setting Valves

If the reverse yoke is placed about three inches from its neutral or out position, a 7/16-in. port opening will be produced, and this gear should not be squared in any other posi-

tion by trailing. The length of the auxiliary reach rods is something that should be looked after before running the locomotive over. When the tumbling shaft arms are plumb, the gear reach rods on both sides should be adjusted, if necessary, to maintain the dimensions furnished by the manufacturer. It will seldom be necessary to make any further change to correct an error in the total travel.

The exact cut off which will give the best results in squaring valves by trailing is not so particular with the Walschaert gear, but good results are obtained by setting the reverse lever so the center of the link block pin is from 2½-in. to 3-in. from the center of the link trunnion. This position will produce a 7/16-in. to a ⅝-in. average port opening. Engines equipped with this gear will not be square in every reverse lever position but if square in the hooked-up position, they will not show out more than ⅛-in. when the reverse lever is in the corner notch.

Figuring Eccentric and Valve Rod Changes

Most books on valve gear devote several pages to the method used to figure eccentric and valve rod changes on the Walshaert and Baker gears. Arbitrary rules are set down which often prove a stumbling block to apprentices and others because no clear reason is given. I have found the following formulas very handy for quickly obtaining the correct alteration for these rods:

Let *a, b, c* and *d*, represent the lead marks or port openings when setting valves of this kind by trailing. Adopting the conventional form for representing the condition of the valve gear and letting the arrow indicate the front of the engine, we have:

$$\frac{a}{c}\Big|\text{———————}\Big|\frac{b}{d}\rightarrow \quad \begin{matrix}\text{forward motion}\\ \text{back motion}\end{matrix}$$

When the eccentric rod is the correct length we know the following relation exists between the leads:

$$a - b = c - d$$

Let x represent the valve movement produced by the eccentric rod error and we have the equation:

$$a + x - (b - x) = c - x - (d + x)$$

Solving we have equation 1:

$$x = \frac{b + c - d - a}{4}$$

This is the amount the valve must be moved. To obtain the actual eccentric rod change multiply x by the ratio of the gear, which varies with different reverse lever positions. If x is a positive number, lengthen the eccentric rod; if negative, shorten it. If the travel marks fall inside the port marks, carry the amount blind as a negative number.

The approximate ratio used to figure the eccentric rod change may be found by dividing the valve travel (at the cut-off where the locomotive trailed) by the throw of the eccentric crank. With a short cut-off the ratio will be a little greater than indicated by this method, for the valve is partly under the influence of the combination lever at the point of maximum port opening. This ratio may be obtained by trial by dropping the front end of the eccentric rod, tramming from the link heel hole center to some stationary point, also tramming the valve rod, and then moving the link, noting the ratio between the line separation at the link heel and the valve stem. In full gear the point of maximum port opening occurs when the combination lever is in the vertical or out position, and the valve travel divided by the eccentric throw is the exact ratio of the gear.

A formula may be also used to figure the valve rod change: Let *a, b, c* and *d*, represent the leads as above.

Let x represent the valve rod change. When the valve rod is the correct length we know that:

$$a - b = d - c$$

An eccentric rod error effects opposite motions in opposite directions. We may now set up the equation:

$$a + x - (b - x) = d - x - (c + x)$$

Solving we have equation 2:

$$x = \frac{b - a + d - c}{4}$$

As before, if x is positive lengthen the valve rod, if negative shorten it.

To illustrate how these formulas may be used suppose the following condition exists:

$$\frac{1/4}{5/8}\Big|\text{———————}\Big|\frac{3/8}{0}\rightarrow \quad \begin{matrix}\text{forward motion}\\ \text{back motion}\end{matrix}$$

Substituting these leads in formula 1, we have:

$$\frac{3/8 + 5/8 - 0 - 1/4}{4} = 3/16$$

Since the 3/16 is a positive number, lengthen the eccentric rod 3/16 times *R*, the ratio of the gear. This proves, for after the change is made the example becomes:

$$\frac{7/16}{7/16}\Big|\text{———}\Big|\frac{3/16}{3/16}$$

By inspection it will be seen that the eccentric rod is the correct length, and that a ⅛ change in the valve rod will square the example. Substituting in formula 2, we have:

$$\frac{3/8 - 1/4 + 0 - 5/8}{4} = -1/8$$

This indicates that the valve rod should be shortened ⅛-in.

The use of these formulas is a help to the beginner in valve setting as they indicate the direction of the change as well as the amount. As given, they are applicable to the Walshaert gear or Baker gear when direct in the forward motion. For an outside admission Baker gear the formulas would need a slight change.

In the Walshaert gear the hangers may be checked by finding the still valve position. Here the question of ratio comes up again. It varies with different designs but is usually between 1½ and 2 to 1. If a locomotive is carefully assembled large link hanger changes will be avoided.

Setting cranks to a specified throw seems to give as good results as the more correct method of taking the dead centers, etc., but in using this shorter method the length of the crank should be checked. The throw of the crank may be taken with a long tram on the cylinder or by using a board clamped to the guide yoke. If the center of the crank falls over the hub of the wheel quite accurate results may be secured by scribing a circle on the hub with a diameter equal to the specified throw.

The center of the eccentric crank pin is adjusted to the circle on the hub by the use of a square and scale. In renewing a crank the original setting may be maintained by tramming from the pin center to some stationary point and then adjusting the new crank until it trams the same.

Determining Lead for Stevenson Link Motion

If it is necessary to alter the lead of a Stevenson link motion confusion will be avoided by remembering the following rule: To increase the lead turn the eccentric on the axle in the direction the locomotive runs, that is, to increase the lead, the back-up eccentrics should be turned on the axle in the direction the wheels turn when running backwards, and the forward motion eccentrics in the direction of rotation when the locomotive is running forward. This holds good for any arrangement for admission or motion.

The proper position to trail an engine equipped with the Stevenson link motion is in the full travel or corner notch. In any other reverse lever position both blades effect the position of the valve and the error shown is the resultant of the error of both blades or the error of one blade partly neutralized by the other. It sometimes may be desirable to try the engine in the short cut-off and make any slight changes necessary but as a rule a locomotive with the Stevenson gear squared in the corner notch will be square at any cut-off. This cannot be said of the modern types.

Give Special Credit to Harder Working Boys*

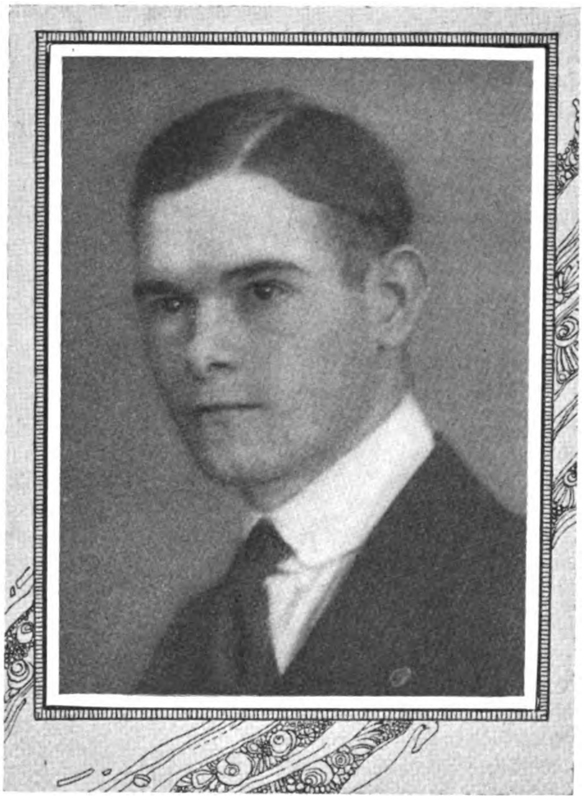
Incentives Are Suggested for Inspiring and Maintaining the Interest and Enthusiasm of the Apprentices

By John M. Wylie
Boiler Maker Apprentice, Erie Railroad

THE young men who usually decide to learn a trade are those whose parents are financially unable to permit them to continue their education or those who, unwilling to study, choose a trade with the mistaken idea that study is unnecessary in that occupation. While the first are apt to begin with a handicap due to lack of education, they are likely to advance more rapidly than those who are too lazy to take advantage of study where it is offered. The reason for lack of advancement is usually due to the fact that the latter type are in the majority.

Various railroad systems at one time or another have established what is known as apprentice schools. These schools are usually equipped in an up-to-date manner. They are headed by competent instructors who, in most cases, have both practical and technical knowledge and conduct classes in mechanical drawing, arithmetic, the principles of plane and solid geometry, and practical and theoretical mechanics pertaining to the trade.

In a shop where there are many apprentices, there is a great deal of work for the instructor thoroughly to familiarize the young men with these subjects. There should be given at least four continuous hours of instruction per week. The instructor can usually pick out the boys who are eager and willing to receive a better education. It is only fair that they should be given longer school hours as compensation.



John M. Wylie

It is difficult to obtain a man who has a thorough practical knowledge of all the trades in railroad shops. If the instructor is assisted by competent men, chosen from different departments, it will give the boys a broader knowledge of the trade. When a difficult or special job is undertaken in the shop the foreman should have an apprentice working with the mechanics.

Apprentices should be transferred from one class of work to another every three months, the instructor, not the foreman, having the authority to do this. It is only natural for the foreman to keep an apprentice on the work he is especially good at, but this is not fair to the boys.

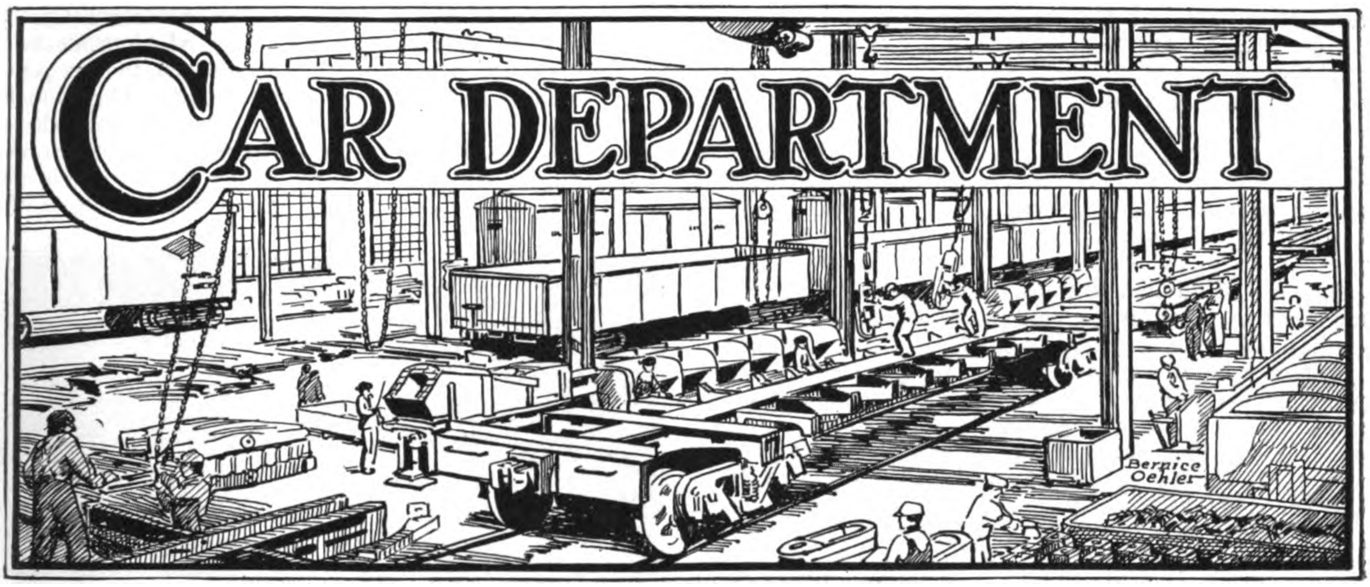
During business slumps as many apprentices as possible should be retained. When an apprentice is serving his time on the basis of the number of days of work per year, and is laid off a great many days a year due to business depressions, at the end of the year he may be as far as three months behind his required time. If this happened for four years in succession the apprentice would be practically losing a year's time, or serving a term of five years. He would naturally lose interest and seek another position with steadier work. Other boys seeing these things turn towards other positions.

The only way to make a thorough mechanic is to keep him interested in his work at all times. Give the young men who are eager to better themselves something to look forward to. The apprentices giving their utmost attention to their work, both practical and technical, should be compensated in some way. If an apprentice is particularly good in the trade he chooses to learn, shift him to another department and then to another. By doing this he will get a general knowledge which will later fit him to become not only a foreman but a general foreman. A short trip to some larger shop given semi-annually to apprentices whose marks are above a certain average for that period gives the apprentice something to work hard for. You will find those who have the passing marks are not doing it for the trip, but for the experience they will gain by seeing how the work is done in various shops. The boys who are unfortunate will try just that much harder to pass the next time.

Some people claim that the public libraries are the greatest institutions in the world. The apprentice schools should have a library, not only equipped with mechanical books, but with English and commercial books as well; also mechanical magazines. This library should be for the use of the apprentices. There are many men in business today who if they have to write a business letter rely upon their stenographers to punctuate, spell difficult words and also word the letters properly. The apprentice should be taught these things to fit him for high positions.

AN ATTRACTIVE BULLETIN board is a vital factor in safety. Many accidents are preventable by education. Safety bulletins should be prominently displayed to get best results. Committeemen should watch the safety bulletin boards and call the attention of others to them. Where they are found untidy and to contain obsolete bulletins report should be made to the committee chairman.—*A. C. L. Circular.*

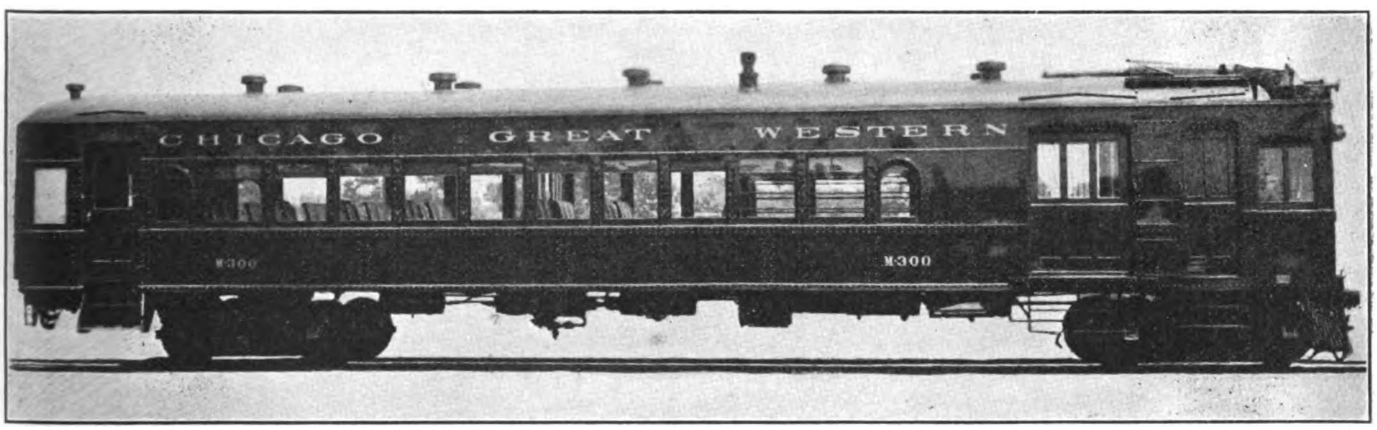
* Awarded honorable mention in the Apprentice Competition which closed September, 1923. The prize and other contributions which have thus far been published will be found in the *Railway Mechanical Engineer* for January, 1924, page 11; February, page 86; March, page 153 and April, page 213.



New Development of the Gas-Electric Car

The Electric Transmission Permits a High Acceleration and Torque at Low Speeds

About three years ago the General Electric Company and the Electro Motive Company, Cleveland, Ohio, began the development of a new type of gas-electric motor car. The first cars of this type have just been delivered, one each to the Chicago Great Western and the Northern Pacific. The cars are driven by a 175-hp. gasoline motor, direct connected to a 110-kw. 700-volt generator which supplies power to two railway motors mounted on the power truck. They weigh approximately 70,000 lb. each, are 57 ft. 4 in. long over the body, by 9 ft. 9⅜ in. over the belt rail, and have a maximum seating capacity in the passenger compartment of 59 persons, with 72 sq. ft. of floor space in the baggage compartment. The seats on one side are 54 in. long and on the other side 37 in. long, seating three and two persons per seat, respectively. The aisle clears 22 in. wide.



The Gas-Electric Motor Car Developed by the Electro-Motive Company, Cleveland, Ohio, Has a Seating Capacity of 59 Persons

Construction of Car Bodies

The car bodies and trucks were built by the St. Louis Car Company. The car bodies are of steel construction with an underframe, the design of which is considered sufficiently rigid to withstand the shocks and buffing strains caused by occasional impacts with heavy standard equipment. They are equipped with single windows, but the frames are designed to receive additional storm windows. The floors are double with 1-in. hair felt insulation between. The side walls are similarly insulated up to the height of the belt rail, behind the letter board and under the roof. The entire design conforms closely to steam railway practice.

The car body is divided into four sections. At the front is the engine compartment, which is 8 ft. long. This contains the engine-generator set, the radiator and cooling fan, the air compressor and the operator's station, with the necessary gages and controls. Behind this are, in their order, the baggage and passenger compartments. At the rear is a vestibule with side door entrances, which is 6 ft. 3 in. long. This contains the toilet.

Description of the Power Truck

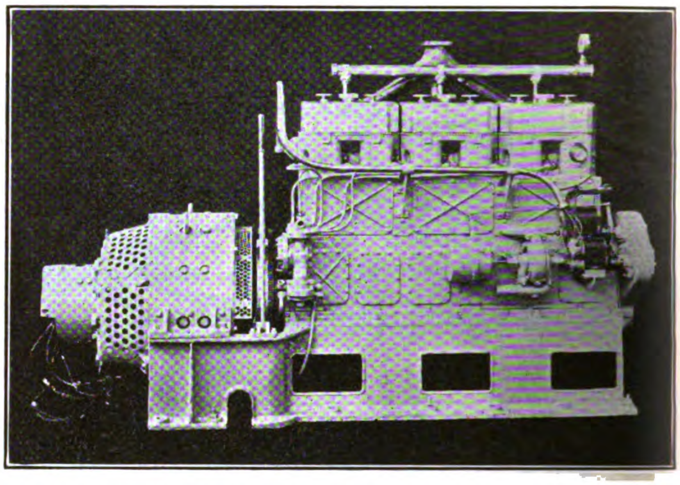
The power truck is a high-speed electric railway type, built with M. C. B. journals and bearings and equipped with

two 105-hp. General Electric railway motors. This truck carries a load of 41,000 lb. at the rail. The cars have sufficient power to pull a standard 30-ton coach and make schedule speed in average branch line service. The maximum speed for which the car is designed to run on level grade is 50 miles per hour. Operating at this maximum speed under level grade conditions and making stops of one minute duration averaging eight miles apart, the maximum average schedule speed of which it is capable is 40.2 miles per hour. On the basis of the same conditions as to the frequency and duration of stops, the maximum average schedule speed decreases as the grade increases, to 22.8 miles an hour on a 2 per cent ascending grade.

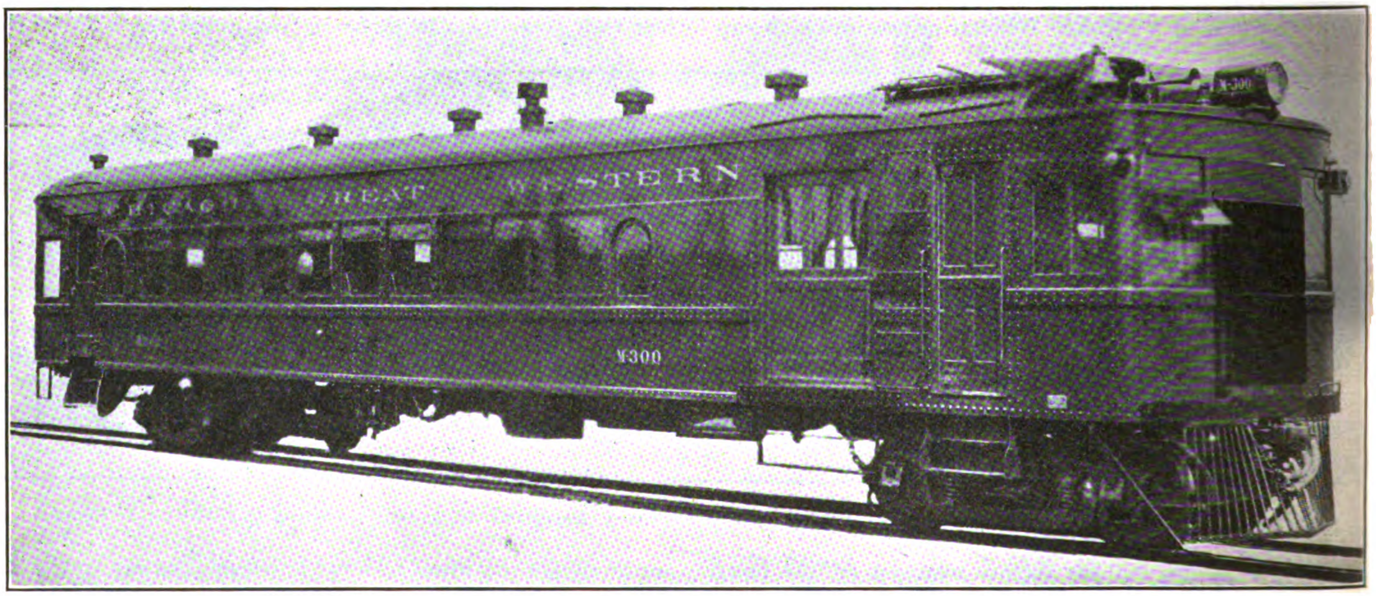
Before work was started on the car, an extensive survey was made to determine, first, the size in greatest demand and, second, the performance requirements. This survey indicated quite clearly that while there was a demand for cars of various sizes, a car seating 55 to 60 passengers with 75 to 100 sq. ft. of baggage space and with sufficient power to pull a 30-ton standard coach over grades of 1½ to 2 per cent, making the average branch line schedule, came the nearest to meeting most motor car requirements. Additional requirements which it was found should be met are a high rate of acceleration and provision for double end control.

The General Electric Company already had built more than 90 gas-electric motor cars from 1908 to 1912, some of which have passed the million mile mark in service and are said still to be showing remarkable operating economy. The problem, therefore, was to develop a new car around the old. Great strides have been made in the development of the gas engine and in electric practice since the original gas-electric cars were designed, and the experience with the old cars was also invaluable.

The survey indicated that the car should not exceed a light weight of 35 tons and, furthermore, that it should be equipped with a railway type engine rather than an automotive, stationary or marine type, as these all have characteristics not suited to railway service. The Winton Engine Works, Cleveland, Ohio, co-operated in the new development and a railway type gas engine was designed around a marine type which has been in successful service for years. This engine has six cylinders of 7 in. bore by 8 in. stroke, with overhead valves and develops 175 hp. at 1,000 r.p.m. It is of rugged construction having a 4-in. crank shaft supported in seven main bearings carried in the lower half of the engine base, thus forming a firm foundation for the revolving and reciprocating parts. The cylinders are built up of a special grey iron water jacket cast in one piece, with cylinder sleeves of semi-steel inserted. The cylinder heads, which are cast in pairs, contain all intake and exhaust passages as well as the valve seats. This entire cylinder and cylinder head assembly is bolted to the upper half of the aluminum crank case. In the design of the engine the problem of its maintenance on the railroad has been carefully taken into consideration. All working parts have been made accessible and the engine is so mounted that any assembly or part of it may be repaired without disturbing the auxiliary apparatus. United States standard threads and bolt sizes have been used throughout.



The 175-hp. Gas Engine-Generator Unit Which Is Placed Transversely Over the Forward Truck Bolster

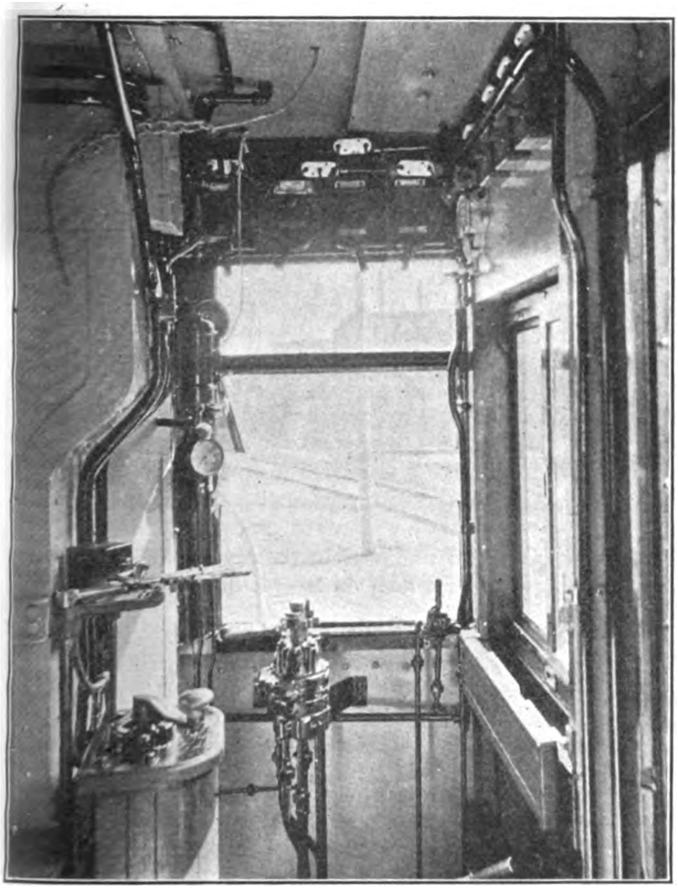


Air Is Drawn Through the Radiator by An Electric Motor-Driven Fan Controlled by a Thermostatic Governor

Since the power of the engine is transmitted electrically, the location of the engine and generator is not fixed by the requirements of transmission. In this car, instead of being located along the longitudinal center line of the car at the forward end of the engine room, the engine and generator unit are located transversely directly over the center of the truck at the rear of the engine room. The body bolster for the forward truck is designed to form the engine foundation. The operation of the car is controlled by what is

termed locomotive control, embodying field control of the generator and throttle control of the engine. The apparatus consists of a series-parallel control with forward, backward and neutral positions, in any one of which a wide range of speed control is available by the locomotive type throttle directly connected to the engine carbureter. No automatic mechanism is involved in this type of control and a locomotive engineer has no difficulty in learning to control the car successfully after a few minutes' practice.

The electric transmission permits a high acceleration and torque at low speeds and permits of operation in both directions with equal performance. The engine speed has no direct relation to the car speed and hence the maximum power of the engine can be utilized at low car speed under severe operating conditions while, on the other hand, a high car speed may be obtained with a low engine speed when low



Operator's Compartment Showing the Control Apparatus

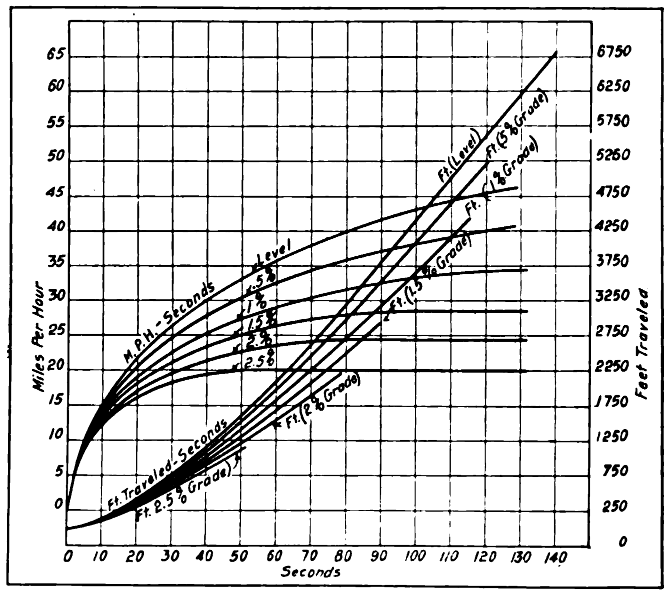
power output is required, thus tending to promote fuel economy and low engine maintenance.

Methods of Engine Control

Three methods of starting the engine are available. A 32-volt starting motor, drawing current from a storage battery, engages the fly wheel. There is also a compressed air starting device which supplies air from the main reservoir of the brake system through a distributor on the cam shaft to each of the cylinders. A standard car hose connection is fitted to the main reservoir pipe so that air may be drawn from any outside source available in emergencies. An effective hand cranking device is also supplied which may be operated with ease and without danger to the operator.

The engine cooling system includes a radiator of ample size which is mounted in the front end of the car, air being drawn through it by an electric motor-driven fan controlled by a thermostatic governor. The radiator is equipped with a manually controlled shutter so that with the variable speed fan and a conveniently located engine temperature gage, a uniform engine temperature, irrespective of atmospheric conditions, may readily be maintained. A convenient connection between the hot water car heating system and the engine cooling system is provided to keep the engine and radiator warm and from freezing when the car must be tied up where there are no terminal facilities. A 32-volt storage battery provides current for car lighting, generator excitation and motor cranking. This battery is charged by a 1½-kw., 32-volt generator mounted on the main generator shaft and enclosed in the same case.

The Chicago Great Western car was operated from the plant of the St. Louis Car Company, St. Louis, Mo., to Chicago, over the line of the Chicago & Alton. At Granite City, Ill., the car picked up a train crew and caboose which weighed 36,000 lb., and, with this load, was able to make passenger train schedule time over the Alton hill with its 1.4 per cent grade. The caboose was cut off at Springfield, Ill., and the car continued on to Chicago light.



Calculated Time-Speed and Time-Distance Curves for the New Gas-Electric Car

The average schedule time from Bloomington, Ill., to Chicago was 43 miles an hour and the average gas consumption for the entire trip was 4 miles per gallon. On the trip two operators handled the car, neither of whom had had any previous experience with it. For the first half of the trip a member of the Electro-Motive Company organization handled the car and on the last half of the trip a representative of the Chicago Great Western took charge and operated the car.

One of the illustrations shows a theoretical time-speed distance curve calculated for these cars. Such tests as have so far been made indicate considerable improvement on what is shown in the diagram. One acceleration test included starting the engine and getting the car under way to a speed of 30 miles an hour in 33 sec.

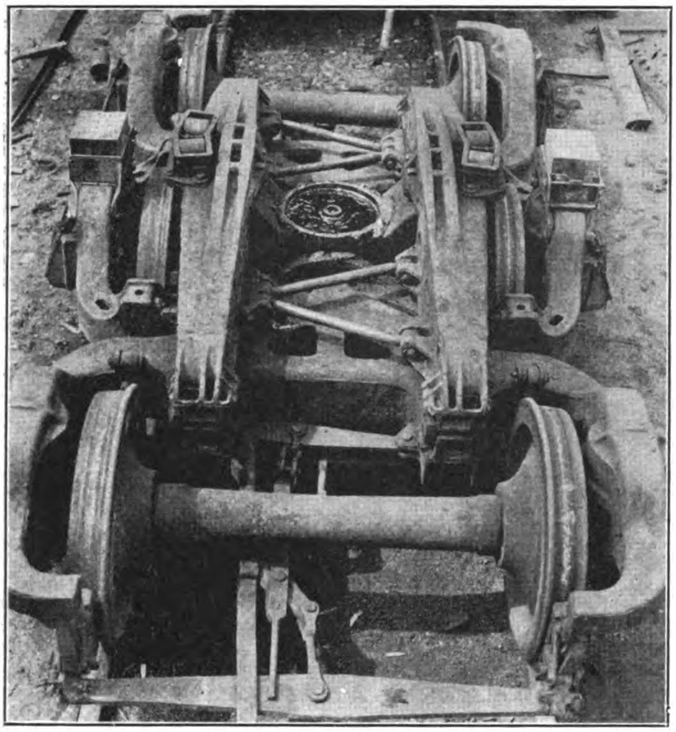
Burlington Dismantles Cars at Eola—A Correction

In the table on the Cost of Dismantling Ten Steel Gondolas at the Eola Reclamation Plant of the Chicago, Burlington & Quincy on page 497 of the August issue of the *Railway Mechanical Engineer*, the value of good material reclaimed as given under the heading "Credits," is $152. This should have been $1,152.

The Boyden Six-Wheel Co-ordinating Truck

Improved Design Eliminates Excessive Swaying and Reduces Maintenance Expense

THE Boyden Steel Corporation, Baltimore, Md., has recently completed a number of tests on a set of demonstration six-wheel trucks of its co-ordinating type. These trucks, in which are embodied a number of improvements over those described in the May, 1923, issue of the *Railway Mechanical Engineer*, were placed under a Virginian railway gondola car of 120 tons capacity. This car was placed in service last May and was in continuous use since that time for carrying coal from the Pocahontas fields in West Virginia to tidewater at Sewells Point, Va.



Top View of the Co-ordinating Six-Wheel Truck

The improved truck, which is known as type C-2-S, is the result of development work initiated by George A. Boyden and consummated by the present Boyden organization. Tests were first made on a full sized truck at the Camden Iron Works, Camden, N. J., to determine its action in passing around various curves. This truck, which was intended for a 120-ton capacity freight car, weighed 22,000 lb., but by making a number of modifications in the design, the weight was reduced to 19,600 lb. Trucks of this type were placed under a 100-ton capacity coal car belonging to the Chesapeake & Ohio, and tests were made in 1920 and 1921 at the plant of the Cambria Steel Company, Johnstown, Pa. These tests resulted in further improvements and a third design was tested out over the Baltimore and Cumberland divisions of the Baltimore & Ohio. A brief account of these tests is also included in the article in the *Railway Mechanical Engineer* which described the earlier model.

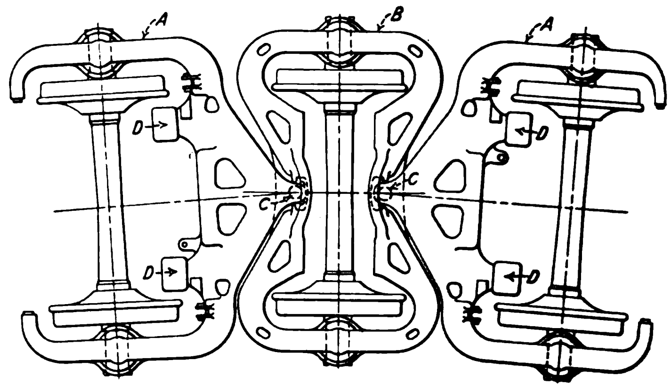


Fig. 1—Plan View, Showing the Frame Construction

Purpose Is to Reduce Curve Resistance

The purpose of the Boyden co-ordinating truck is to reduce curve resistance and to permit greater vertical flexibility. This is accomplished by a construction which permits the wheels and axles to assume their normal relation with the track under all conditions.

Fig. 1 shows a plain view of the understructure of this truck. The two end frames *A*, to which the end wheels are applied through a pedestal type spring supporting journal boxes, carry the bolster reactions to a center frame *B* through a ball and socket joint *C*, located on the longitudinal center line of the truck. The bolster reactions are transmitted first to the end frames *A* at the points *D*. The longi-

Gondola Car of 120 Tons Capacity Used for Testing the Boyden Co-ordinating Six-Wheel Truck

tudinal location of the bolster reaction, points *D*, is such that equal loads are carried on the three axles. It will also be noted that the end frames *A*, which are integral castings, have a three-point support.

Fig. 2 shows an inverted plan of the articulated bolster. Rockers of manganese steel are interposed between the reaction points *D* of the bolster and those of the end frames *A* in order to eliminate friction.

The bolster, composed of three main members, is so designed as to allow maximum vertical flexibility, combined with horizontal rigidity, which prevents longitudinal displacement of the two parallel beams with respect to each

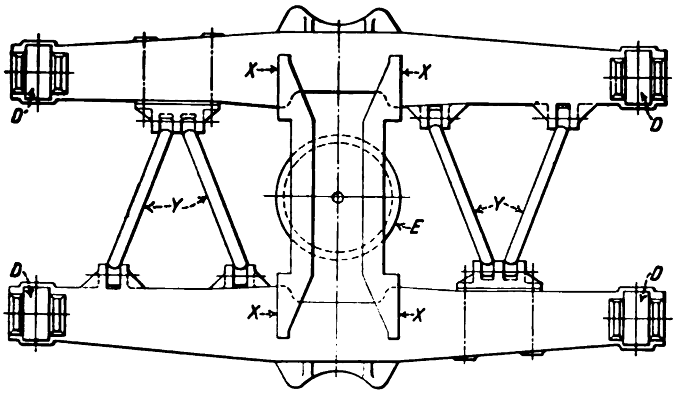
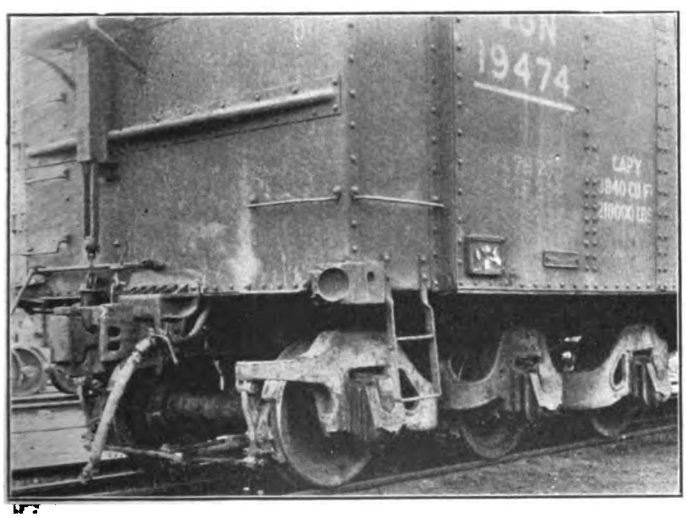


Fig. 2—Triangulated Ties Hinged at the End Prevents Longitudinal Displacement of the Parallel Bolster Beams

other. This condition is secured by use of triangulated ties *Y* hinged at their ends to the longitudinal beams by means of the common I-bar construction.

The center bearing bridge *E* carries the center plate load of the car. This member projects vertically downward and straddles the center axle. In passing through the center frame *B*, the parallel surfaces *X* of the bridge are located with a minimum clearance between these and similar sur-



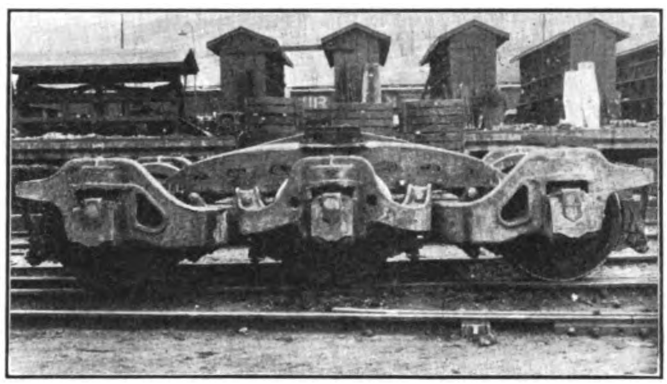
All Parts of the Truck Are Designed with the View of Facilitating Inspection

faces on the center frame *B*. Thus it will be seen that the transverse axis of center frame *B* is maintained at right angles to the longitudinal axis of the bolster, as well as to the track. When on a curve the center wheels are offset with respect to the end wheels; a transverse movement must, therefore, be provided for of the center frame. This is permitted by sliding the relative surfaces *X* of the center frame and bolster bridges and is limited only by the contact of the bridge *E* with the center wheel. Sufficient clearance at this point is provided for the trucks to negotiate a curve with a 65-ft. radius.

New Design Includes Additional Features

An interesting feature aimed to eliminate excessive swaying of the car has been incorporated in this design. It will be noted in Fig. 1 that the center wheels receive equal loading under all conditions of equal or unequal bolster loading on account of the midway location of the load reaction points *C* on the center frame *B*. Thus the center wheels may be loaded in excess of their normal static load, or equal in amount to the loading of the end wheels under moving car conditions.

It will be noted in the illustration showing a top view of the truck that car snubbing blocks are applied over the springs of the center journal. These blocks are not used on the production design, but are arranged separable for test purposes. The top surfaces of the blocks are at a lower elevation than the top surfaces of the side bearing rollers. When the leading or trailing wheels pass over a depression or low track joint, they permit the bolster, and thus the truck side bearing on that side, to drop with them, thereby removing car support on that side. The center wheels, which are 5 ft. from the end wheels, are on level track. At the instant that the side bearing support of the car is removed and the car starts to roll to that side, the chafing



Side View of the Boyden Truck, Showing the Construction of the Frame and Bolster

plate of the snubbing block comes in contact with the car floor and arrests the movement of the car before it accumulates any appreciable momentum. In a very short increment of time, the leading or trailing wheel is again on level track and the side bearings steady the car as the center wheel in its turn drops into the rail depression. This feature has been found to reduce the car oscillation at critical speeds to a marked degree, and without overloading of the center journals.

The Design May Be Varied to Suit Conditions

The Boyden trucks, from the nature of their construction, can be designed for a maximum wheel base. The demonstration trucks are equipped with wheels having a total wheel base of 10 feet. This produces a satisfactory distribution of the load to the rails, roadbed and structures, which tends to reduce maintenance of way costs.

It can be seen from the side view of the truck that all of the important parts are accessible for inspection. This is an important feature of the truck and can be appreciated by those who have the responsibility of safe operation of cars. The clasp brake rigging is also as easily accessible as the main members of the truck. Shoe replacements can be made without removal of the dependent parts and can be accomplished without unnecessary loss of time.

The four main members of the truck are self-interlocking

and require no bolts, pins or rivets to complete the assembly. Springs located over the journal boxes cushion the rail impacts before these depreciating forces enter the truck structure and thus retard crystallization of its cast steel members.

The following advantages are claimed for this truck:

1—Safe operation under abnormal loading and truck conditions secured by a snubbing of the car oscillation and thereby obtaining better vertical equalization with the attendant elimination of the hazard of lifting wheels.

2—High speeds are made possible for modern freight cars of greater capacity.

3—The curve resistance is reduced to a minimum due to the frame construction which permits all the wheels to adjust themselves to the curve, with a corresponding reduction in drawbar pull and reduced wear on the wheels and rails.

4—Equal flange and tread wear on all six wheels is obtained owing to the radial position assumed by the axles on curves.

5—Better distribution of rail loading is secured by the greater wheel base with an attendant reduction in maintenance cost.

6—The main members of the truck, center frame, two end frames and complete bolster are composed of four self-interlocking parts which require no bolts, rivets, or pins in their assembly.

7—All parts are designed with the view of facilitating inspection in order to reduce the hazard of unseen faults and fractures.

8—The clasp brake rigging is of a simple special design and all parts are visible for proper inspection and maintenance. Replacement of brake shoes can be made without removal of any of the dependent parts.

Shearing Stress in Passenger Car Side Girders

Analysis of Procedure Necessary in Order to Reduce Weight Without Sacrificing Strength

By Wendel J. Meyer

THE new light-weight coaches which recently have been placed in service on several railroads are constructive steps toward reduction of the weight of steam road passenger cars. Although designed for suburban service exclusively, their success, no doubt, will predicate an earnest attempt to reduce the weight of main line equipment. Mooted questions of car design, often have been settled by adding excessive weight in order to err on the side of safety. To reduce weight successfully without sacrificing essential requirements of strength, calls for more careful consideration of the engineering principles involved.

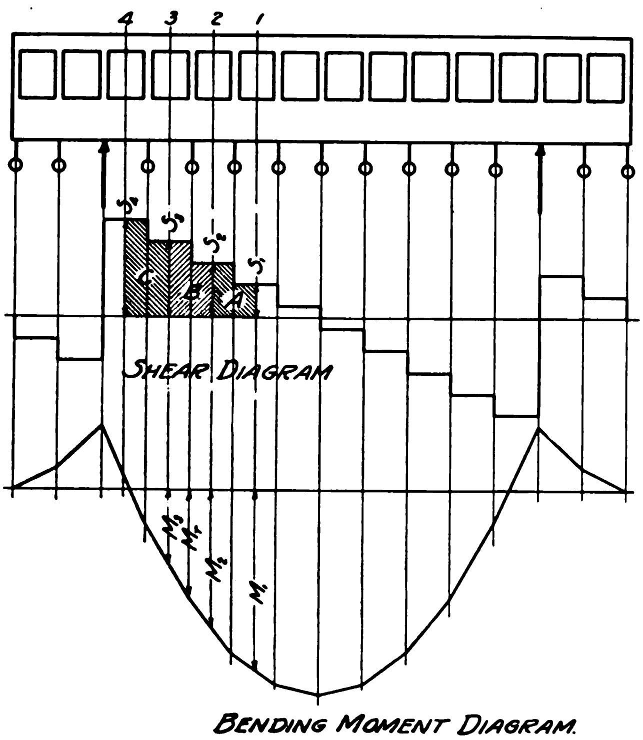


Fig. 1—Shear and Bending Moment Diagrams

The design of the load-carrying side girder presents a number of interesting points. To calculate the bending moment and then divide it by the calculated section modulus of the assumed girder section in order to arrive at prescribed tensile and compressive stresses, does not always assure the ability of the girder to withstand its loads. The investigation is not complete until the shearing stress also has been taken into consideration.

This article is an attempt to explain the action of vertical and horizontal shear; to show the action of the upper and lower chords in resisting vertical shear; to describe the function of the side posts in resisting horizontal shear; to point out the effect on the side girder if the shear is not resisted properly; and to call attention to the action of the center sill in assisting the resistance to shear.

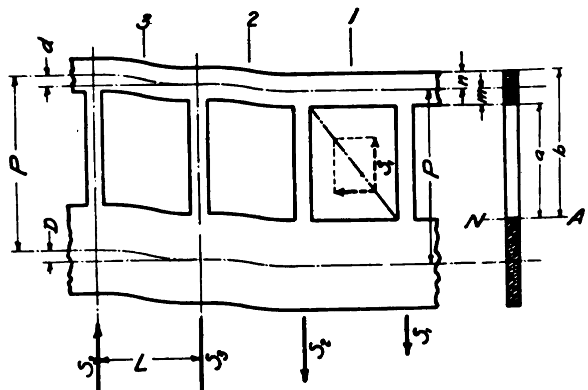


Fig. 2—The Shear in the Chords of a Typical Girder Section

Vertical Shear

Fig. 1 shows the bending moment and shear diagrams of a side girder, which, in order to simplify explanation, is assumed to be loaded by equal weights concentrated at the post centers. The girder section is assumed constant throughout the length of the girder and is represented in Fig. 2; to further facilitate explanation, the neutral axis NA, is assumed to coincide with the top of the lower chord.

The shear diagram of Fig. 1 shows the vertical shear at section No. 1 to be S_1. If the upper and lower chords were pin-connected at their ends, a diagonal as shown at window opening No. 1 of Fig. 2, would be necessary and the vertical component of the force in the diagonal would be S_1. It then follows that omission of the diagonal tends to flex the upper and lower chords as shown at panels No. 2 and No. 3 of Fig. 2. The shear, therefore, produces bending stresses in the chords, which must be added algebraically to the stresses due to the moment given by the bending moment diagram.

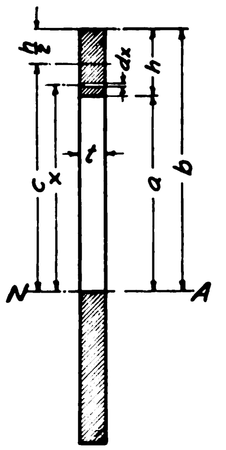


Fig. 3—The Girder Section Analyzed for Chord Stresses

Assuming the posts to be capable of resisting horizontal shear, the vertical shear S_3 will cause a bending moment

$$M_v = \frac{L}{2} S_3$$

which must be resisted by the chords of panel No. 3. The dimension P will not change appreciably because the posts are subjected to low direct stress and so the deflections d and D of Fig. 2, may be assumed to be equal. The upper and lower chords, therefore, are redundant beams of equal deflection and length and so the amount of M_v taken by each will be proportional to the rigidity of each beam which, in turn, is proportional to its moment of inertia.

Let I_U and I_L be the respective moments of inertia of the upper and lower chords, taken about their individual neutral axes. The bending moments due to shear will then be:

$$M_{UV} = M_V \frac{I_U}{I_U + I_L} = \frac{L\ S_3\ I_U}{2(I_U + I_L)} \text{ (on upper chord)}$$

$$M_{LV} = M_V \frac{I_L}{I_U + I_L} = \frac{L\ S_3\ I_L}{2(I_U + I_L)} \text{ (on lower chord)}$$

At the right hand post of panel No. 3, M_V causes compression in the top fibres of the chords and tension in the bottom fibres while at the left hand post the top fibres are in tension and the bottom fibres in compression. It is necessary, therefore, to investigate the sections at both posts but the procedure for the upper chord at the right hand post only, is given here.

Let M_T be the bending moment as taken from the diagram of Fig. 1 and let I be the moment of inertia of the total section, taken about $N\ A$ of Fig. 2; the symbols a, b, m and n are described by Fig. 2. The unit stress on the top fibre of the upper chord is:

$$f_t = -\frac{M_{UV}\ n}{I_U} - \frac{M_T\ b}{I}$$

and the unit stress on the bottom fibre of the upper chord:

$$f_b = +\frac{M_{UV}\ m}{I_U} - \frac{M_T\ a}{I}$$

It is apparent that f_t will be compressive but the sign of f_b will depend upon the numerical values of the component terms. It should be noted that terms containing M_{UV} are numerically maximum for panels near the bolsters and minimum at the center of the car, while the terms containing M_T are maximum at the center and minimum near the bolsters.

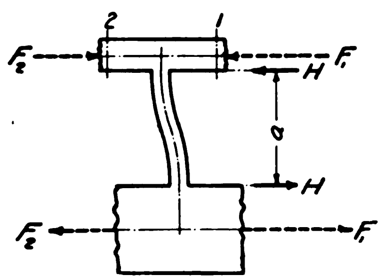


Fig. 4—Horizontal Shearing Effect Caused by the Changing Moments

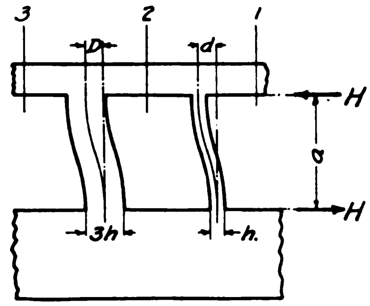


Fig. 5—Typical Section with Wide and Narow Posts

Force in Chords and Statical Moment of Section

Fig. 3 represents the same girder section as described by Fig. 2. If the section acts as a unit and is subjected to a bending moment M, the unit stress on the fibres distant x from $N\ A$, will be $M \times x \div I$, where I is the moment of inertia of the whole section, taken about $N\ A$. A very small portion distant x from $N\ A$, of width t and depth dx, will have an area of $t \times dx$. The force acting on this area will then be

$$(t\ dx)\left(\frac{M\ x}{I}\right) = \frac{t\ M\ x\ dx}{I}$$

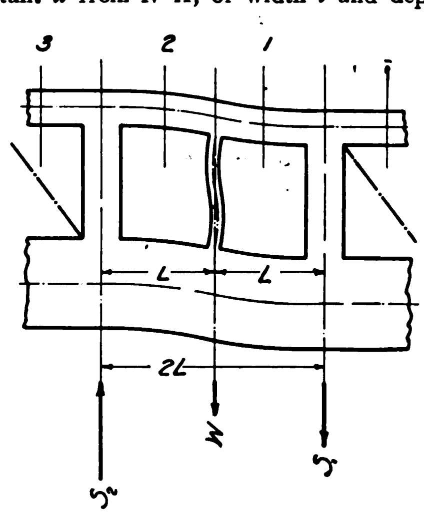


Fig. 6—Effect of Unbalanced Post Sections

The total force F which acts on the whole section of the upper chord, is obtained by summing up all the small portions of which it is composed or, in other words, by integrating between the limits $x = a$ and $x = b$. This summing up is done by means of calculus and results in

$$F = \frac{t\ M}{2\ I}(b^2 - a^2) = \frac{M}{I}\left(\frac{b + a}{2}\right)(b - a)\ t$$

Reference to Fig. 3 shows that

$$h = b - a \text{ and } b = c + \frac{h}{2} = c + \frac{b-a}{2} \quad \text{or } c = \frac{b+a}{2}$$

Therefore

$$F = \frac{M}{I} c\,(h\,t) = \frac{M}{I} c\,A$$

where A is the area of the upper chord.

The quantity $c\,A$ is known as the statical moment M_s of the section about $N\,A$. It is obtained by multiplying each component area included between the horizontal plane of shear and the extreme fibre, by the distance from the center of gravity of the component area, to the plane under consideration. The statical moment is a maximum for the plane through the neutral axis and so the maximum horizontal shearing stress is at the neutral axis of the section. Substituting $M_s = c\,A$ in the above equation, there results:

$$F = M \frac{Ms}{I}$$

Horizontal Shear and Its Effect on the Posts

Fig. 1 shows the bending moments at sections 1 and 2 to be M_1 and M_2 respectively. Then the compressive forces

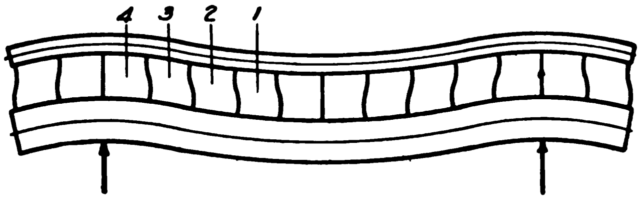


Fig. 7—The Action of Flexible Posts Incapable of Transmitting Horizontal Shear

F_1 and F_2 acting on the upper chord at sections 1 and 2 are

$$F_1 = M_1 \frac{Ms}{I} \quad \text{and} \quad F_2 = M_2 \frac{Ms}{I}$$

The action of F_1 and F_2 is illustrated by Fig. 4 where F_1 is greater than F_2 because M_1 is greater than M_2. The difference between F_1 and F_2 is

$$H = F_1 - F_2 = \frac{M_1\,Ms}{I} - \frac{M_2\,Ms}{I} = \frac{Ms}{I}(M_1 - M_2)$$

Since the bending moment diagram is the integral of the shear diagram it follows that M_1 equals M_2 plus the shaded area A of the shear diagram of Fig. 1. Then

$$M_1 - M_2 = \text{area } A \quad \text{and} \quad H = \frac{Ms}{I}(\text{area A})$$

The force H is the horizontal shear or the tendency of the upper and lower chords to slide past each other, which must

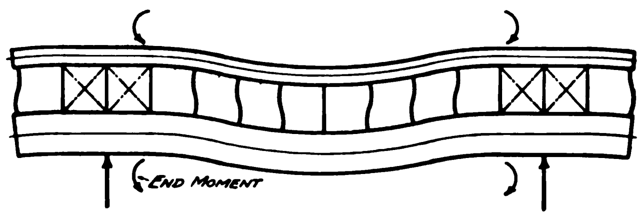


Fig. 8—Showing the Effect of Blank Panels Introduced Near the Bolsters

be resisted safely by the post if the girder is to act as a unit.

If the post is rigidly connected to the upper and lower chords it will bend as shown in Fig. 4 and the bending moment is $H\dfrac{a}{2}$ but if the connection to the upper chord is not sufficient, the bending moment should be taken as $H\,a$.

Effect on Alternate Wide and Narrow Posts

If the posts are alternately wide and narrow, the typical section will take in two windows as shown in Fig. 5. Then the shear to be resisted by one post of width h and one of width $3h$ will be

$$H = \frac{Ms}{I}(M_1 - M_3) = \frac{Ms}{I}(\text{area A} + \text{area B})$$

The bending moment is $H\dfrac{a}{2}$ and the amount taken by each post will be proportional to its moment of inertia as explained under "Vertical Shear," because d will not be appreciably different from D.

A system of equal posts can be compared to one of alternate wide and narrow posts by assuming all post sections to

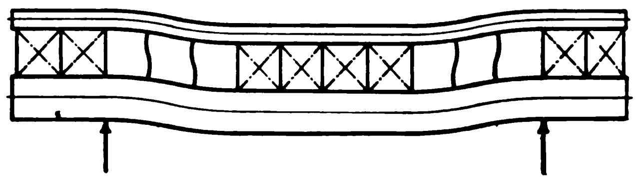


Fig. 9—Illustrating the Action of the Girder Which May Occur Where the Shearing Stresses Near the Center of the Car Are Well Within the Capacity of the Posts to Resist Them

be similar and assigning widths of $2h$, $3\,h$ and h to equal, wide and narrow posts respectively; the window openings of both systems will then be equal. The respective moments of inertia for widths h, $2\,h$ and $3\,h$ are then $K\,h^3$, $8\,K\,h^3$ and $27\,K\,h^3$ and the section modulii: $C\,h^2$, $4\,C\,h^2$ and $9\,C\,h^2$; where C and K are constants of section. The bending moments and stresses will then be as follows:

Width of Post	Bending Moment	Stress
h	$\left(\frac{H\,a}{2}\right)\left(\frac{K\,h^3}{K\,h^3 + 27\,K\,h^3}\right) = \frac{H\,a}{56}$	$\frac{H\,a}{56\,C\,h^2} = .0178\,K'$
3 h	$\left(\frac{H\,a}{2}\right)\left(\frac{27\,K\,h^3}{K\,h^3 + 27\,K\,h^3}\right) = \frac{27\,H\,a}{56}$	$\frac{27\,H\,a}{56\,(9\,C\,h^2)} = .0535\,K'$
2 H	$\left(\frac{H\,a}{2}\right)\left(\frac{1}{2}\right) = \frac{H\,a}{4}$	$\frac{H\,a}{4\,(4\,C\,h^2)} = .0625\,K'$

K^1 is a constant involving H, a, C and h^2.

The comparison shows the stress in the wide posts to be about 86 per cent of the stress in equal posts placed at the

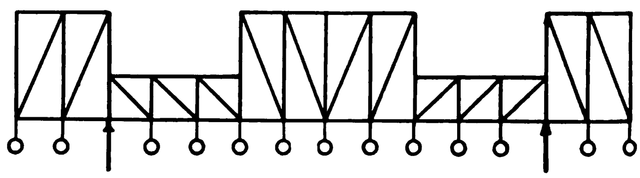


Fig. 10—Truss Diagram Illustrating the Virtual Value of the Girder Shown in Fig. 9

same points. It is questionable whether this reduction warrants the constructional disadvantages encountered in the use of unequal widths of posts. Furthermore, since the narrow post usually will be found incapable of transmitting the shear across its adjacent panels such as $H = \dfrac{M_s}{I}(\text{area } A)$ to which it is subjected, the upper and lower chords will act as shown in Fig. 6; the bending moments in the chords will be materially increased because the vertical shear here must be transmitted over two panels instead of over one.

Effect of Blank Panels at Bolsters

Fig. 7 represents a girder with flexible posts incapable of transmitting any horizontal shear. Here the upper and lower chords are beams with equal deflections, each bending about its own neutral axis because the girder cannot act as a unit since the horizontal shear is not resisted.

Blank panels at or near the bolsters as illustrated by Fig. 8, have been employed with the idea that this construction will enable the girder to act as a unit. But this arrangement does not relieve the posts from the shear action. In order that the girders may act as units, the posts of Fig. 8 must resist the same shear as the posts of Fig. 7. It should be noted however, that the girder of Fig. 8 is considerably stronger and stiffer than that of Fig. 7 because the blank panels virtually constrain the ends of the upper and lower chords and create end moments as shown; the chords approach the condition of beams rigidly fixed at their ends.

Action of the Usual Side Girder

An analysis of the usual modern coach will show that while the posts near the center of car will safely transmit their

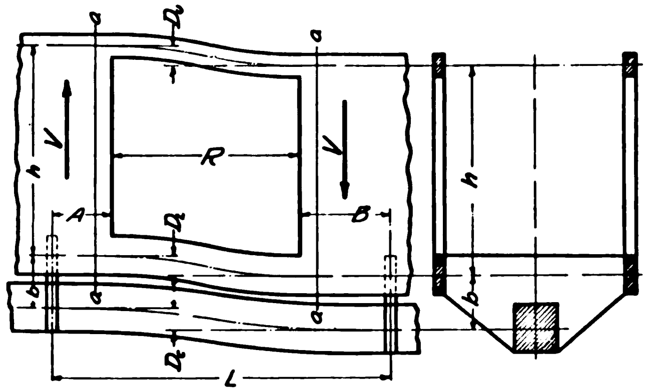


Fig. 11—Frame Members Available to Resist the Vertical Shear at a Door Opening

portion of the shear, the posts near the bolsters are incapable of resisting the shear necessary to produce a unit girder.

Since the bending stresses in the posts are functions of the increment areas of the shear diagram such as area *A*, area *B*, etc., it follows that the post stress depends upon the change of bending moment for adjacent panels of the girder. At the center of the car the change of bending moment is small while near the bolsters, the bending moment changes rapidly. This is shown by the bending moment diagram of Fig. 1; further, reference to the shear diagram shows that the proportion between area *C* and area *B* is greater than that between area *B* and area *A*. Therefore theoretically, beginning at the center of car, the post sections should be increased as the bolsters are approached but, for the sake of appearance, this is hardly desirable, even though it were practicable.

Failure of the posts to transmit the shear adequately, does not mean that the girder will fail under its load because the action illustrated by Fig. 9, may occur. That is, at the center of car the shear is small and the posts are capable of resisting it: thus fully developing the unit girder to resist the maximum bending moment. Near the bolsters, the posts cannot resist the large shear but here the bending moment has decreased to such a value that the entire girder is not needed to resist it; the portion between side sill and belt rail, is capable of resisting the reduced bending moment at this point. Between bolsters and ends, the shear is small and aided by the body corner posts and vestibule end construction, the intermediate posts are capable of resisting it. The virtual effective girder, therefore, is similar to the truss shown in Fig. 10.

This suggests the plausibility of using flexible posts or flexible post connections at those points of the girder where the regular posts are incapable of transmitting the shear safely. Such an arrangement would eliminate possible cracks in the posts at letter board and belt rail. Of course, it would be necessary to determine how far from the center of car the entire girder section is needed to resist the bending moment, to design the necessary rigid posts so that the entire girder section will be assured over this distance and to see that the upper and lower chords acting as redundant beams in way of the flexible posts, are capable of resisting their imposed bending moments.

It should be noted that in the preceding discussion, the action of the center sill in aiding the resistance to the vertical shear, has been neglected. The effectiveness of the center sill will depend upon its rigidity as compared to that of the chords and also upon the location of the crossbearers. The following remarks on the action of the center sill at baggage door openings apply also to its action at window openings.

Vertical Shear at Door Openings

Fig. 11 represents a portion of the side girder at a door opening and shows in section the five longitudinal members—two upper chords, two lower chords and the center sill—which must resist the vertical shear *V*. To simplify the work of calculating, it is necessary to propose the following assumptions, which, while only an approximation of the truth, will not affect practical results appreciably:

First—the cross bearers are assumed to connect, with perfect rigidity, the center sill with the lower chords thus making the dimension *b* of Fig. 11, constant; the usual cross bearer is comparatively short and very rigid.

Second—the ends of the center sill and chords are considered fully restrained; the chords approach this condition closer than does the center sill.

Third—the deflection of the side girder over the lengths *A* and *B* of Fig. 11, is zero; the moment of inertia of section *a* — *a* is very large compared to the individual moments of inertia of each chord and of the center sill.

Fourth—the distance *h* remains constant; the direct stress in the door posts is small and there is no appreciable change in their lengths.

Under these assumptions, all five members must have the same deflection and so the portion of the shear *V* taken by each will be directly proportional to its moment of inertia and inversely proportional to the cube of its length. Let V_U, V_L and V_C be the amount of shear taken by each upper and

	MEMBER	MOM. INER. IN.^{4}	SEC. MOD. IN.^{3}	LENGTH INCHES	VERT. SHEAR LBS.	BEND'G. MOM. INCH LBS.	UNIT STRESS LBS./SQ. IN.
CASE I	SIDE PLT. & RE-ENF'M'T.	12	3	72	940	33,840	11280
	" SILL & "	80	16	72	6260	225,360	14080
	CENTER SILL	700	100	154	5600	431,200	4310
CASE II	SIDE PLT. & RE-ENF'M'T.	20	5	72	1280	46,080	9220
	" SILL & "	100	20	72	6420	231,120	11560
	CENTER SILL	700	100	154	4600	354,200	3540
CASE III	SIDE PLT. & RE-ENF'M'T.	12	3	72	890	32,040	10680
	" SILL & "	80	16	72	5920	213,120	13320
	CENTER SILL.	840	120	154	6360	489,720	4080
CASE IV	SIDE PLT & RE-ENF'M'T.	12	3	72	715	25,740	8580
	" SILL & "	80	16	72	4770	171,720	10730
	CENTER SILL.	700	100	120	9030	541,800	5420

Fig. 12—Table Showing the Effect of Varying the Properties of Chords and Sill

lower chord and the center sill respectively. The deflection of each may then be expressed in terms of its load, length, moment of inertia and a constant *K* denoting the material and the manner in which the load is applied. Using *R* as the length of the chords, *L* the length of the center sill and subscripts of *I* to denote the respective moments of inertia, the expressions for deflection are written and equated as follows:

$$D = D_U = D_L = D_C = K\,V_U\,\frac{R^3}{I_U} = K\,V_L\,\frac{R^3}{I_L} = K\,V_C\,\frac{L^3}{I_C}$$

from which

$$K\,V_U \frac{R^3}{I_U} = K\,V_C \frac{L^3}{I_C} \text{ or } V_U = V_C \frac{L^3 I_U}{R^3 I_C}$$

and

$$K\,V_L \frac{R^3}{I_L} = K\,V_C \frac{L^3}{I_C} \text{ or } V_L = V_C \frac{L^3 I_L}{R^3 I_C}$$

A third equation results from the relation

$$V = 2\,V_U + 2\,V_L + V_C$$

which makes possible the solution for the three unknown quantities, V_U, V_L and V_C as follows:

$$V_U = \frac{V\,L^3\,I_U}{2\,L^3\,(I_U + I_L) + R^3\,I_C}$$

$$V_L = \frac{V\,L^3\,I_L}{2\,L^3\,(I_U + I_L) + R^3\,I_C}$$

$$V_C = \frac{V\,R^3\,I_C}{2\,L^3\,(I_U + I_L) + R^3\,I_C}$$

Fig. 12 is a table in which given properties have been substituted in the above equations using 20,000 lb. as the value of V; the resulting distribution of this shear, the bending moments and the unit stresses are shown. Four cases are given in order to show the effect of varying the properties of the chords and of the sill and changing the spacing of the cross bearers.

Attention is called to the convenient check on the calculated shear distribution from the relation

$$2\,V_U + 2V_L + V_C = V$$

which applied to Case I results in

$$2\,(940) + 2\,(6260) + 5600 = 20{,}000$$

In Case II the resistance of the upper and lower chords has been increased 67 per cent and 25 per cent respectively but the center sill is the same as in Case I. The ratios of moments of inertia and section moduli have been maintained because the depths of the chords are usually limited in practice and increased resistance may be obtained only by the use of considerable additional material. The increased sections have reduced the unit stresses about 18 per cent which is small compared to the material added.

In Case III the chords are the same as in Case I but 20 per cent has been added to the resistance of the center sill resulting in a decrease of five per cent in the unit stresses. It should be noted that since considerable variation of center sill depth is possible, the resistance of the sill can be increased more economically than that of the chords.

The importance of the spacing of the cross bearers is shown by Case IV where the door opening and sections of Case I are used but the distance between cross bearers has been shortened 34 in. Without adding material, the high stresses in the chords have been reduced about 24 per cent while the low stress in the center sill has been increased about 25 per cent.

In the light of this comparison, the advantage of elaborate chord re-enforcement seems doubtful; such re-enforcement certainly is not economical. Moreover, the re-enforcement is only effective when it is carried beyond the door opening far enough to enable its connection to develop its full section. On the other hand, reducing the distance between crossbearers enables the center sill to take a greater share of the vertical shear and, even though the sill be increased to secure additional resistance against the imposed load and the cross bearers be strengthened to transmit the increased center sill reactions, it is obvious that this method is more economical than adding re-enforcement to the chords.

Aishton Addresses Car Inspectors and Foremen

Annual Convention at Chicago Listens to a Large Number of Able Addresses and Papers on Car Subjects

THE twenty-third annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, was held at Chicago, September 23, 24 and 25. Probably at no previous convention of this association was a program presented which contained so many addresses by railroad men acknowledged to be leaders in their respective fields. On the opening day of the convention, R. H. Aishton, president of the American Railway Association, delivered a short address which was an inspiration to the members. F. W. Brazier, assistant to the general superintendent of rolling stock of the New York Central, was also roundly applauded after making a short talk in which he emphasized the absolute necessity of efficiency in the car department if railway operating expenses are to be kept within reasonable bounds. Mr. Brazier said that without the hearty support and co-operation of the car inspectors and car foremen and particularly their efforts to develop competent younger men to fill the ranks, efficient operation of the car department would be impossible.

The subjects of car repairs and lubrication were covered in several individual papers. H. W. Williams, special representative to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, delivered a paper on "Efficiency in Heavy Car Repair Shop Operation," and J. A. Roberts, chief A. R. A. clerk, Chesapeake & Ohio, discussed the subject, "Steel Car Repairs." The subject of "Freight Claim Prevention" was covered by Joe Marshall, special representative, American Railway Association. P. Alquist, master car builder of the Delaware, Lackawanna & Western, read a paper on "Automobile Loading in Closed and Open Cars."

Much favorable comment was heard on the individual paper on "A. R. A. Billing" by B. F. Jamison, special traveling auditor of the Southern. This paper dealt with a subject, the importance of which is under-estimated in some quarters and which some car foremen apparently think can be safely relegated to the billing clerks. Mr. Jamison pointed out in a forceful manner the possibilities of individual roads saving, and conversely losing, not thousands, but probably millions of dollars depending upon whether or not they handle the A. R. A. billing in a systematic manner in accordance with the rules, employing constant checks of all kinds to maintain the accuracy of the work. Abstracts of the papers mentioned, together with the discussion of A. R. A. billing rules and rules of interchange, will be published in this and subsequent issues of the *Railway Mechanical Engineer.*

New Officers

At the suggestion of President Westall, an additional vice-president's office was created, in order that the various incumbents will have a better knowledge of their duties when advanced to the position of president. The new officers of the Chief Interchange Car Inspectors' and Car Foremen's Association are as follows: President, C. M. Hitch, district master car builder, Baltimore & Ohio, Cincinnati, Ohio, first vice-president, W. P. Elliott, general foreman, Terminal Railroad Association, East St. Louis, Ill.;

second vice-president, B. F. Jamison, special traveling auditor, Southern, Meridian, Miss.; third vice-president, E. R. Campbell, general car foreman, Minneapolis Transfer Railroad, Minneapolis, Minn. M. S. Sternberg, master car builder, Belt Railway of Chicago, was re-elected secretary-treasurer, C. J. Hayes, traveling A. R. A. supervisor, New York Central, Yonkers, New York; W. M. Pyle, accountant, Southern Pacific, Tucson, Ariz.; L. Martin, chief car repairer, Baltimore & Ohio, Baltimore, Md., and T. S. Cheadle, chief car inspector, Richmond, Fredericksburg & Potomac, Richmond, Va., are the newly elected members of the Executive Committee.

Address by R. H. Aishton

In his address R. H. Aishton, president of the American Railway Association, spoke in part as follows:

The average layman's or shipper's knowledge of transportation is largely confined to the fact that he may at will be transported from place to place with safety, or that he can consign his goods to advantageous markets with no more personal effort than he might use, in anger, to consign other objects to farther destination. To him transportation is abstract; he has no thought of the detailed work and study that is devoted to perfecting the facility he is using. I venture to say that not one in one thousand shippers knows of the work of the chief interchange car inspector or of the car foreman. Yet what detail of transportation is more essential than that the equipment carrying the commerce of the country be in physical condition to perform the service in which it is engaged?

The position you hold is important or it wouldn't exist. It may not hold a romantic place in the public eye, yet it is essential and upon your work as much as upon any of the other ramified details of the railroad plant rests the responsibility for a smooth working transportation machine which the shipping public has accustomed itself to expect. This is in itself a reward.

The public is chiefly concerned with service and secondarily with the economy and efficiency with which this service is manufactured. One of the things that produced success last year, and is bringing it now, is the movement per car per day. One mile per car per day means automatically adding 100,000 cars to the equipment of the country. You gentlemen can have a large and important part in bringing about that result. Cars in bad order in moving trains cost money in switching out, and entail delay to equipment and freight being carried, on top of the cost of making repairs. This can be reduced to a minimum only by complete knowledge and an intelligent inspection by the inspectors and car foremen.

Expedition in movement of freight depends in a large measure on the care and inspection of cars before loading. Carelessly inspected and prepared cars make it almost an assured fact that the freight will be delayed in transit and possibly require the transfer of the load to a suitable car at the first interchange point; all of which goes to keep down the mileage made by cars and increases the cost, to say nothing of damage to the contents in transfer and general dissatisfaction resulting therefrom.

I note you have a paper on general lubrication. Neglect of proper lubrication and intelligent inspection brings about a tremendous delay to freight and cars, causing dissatisfaction on the part of shippers, addition to the switching expense and brings about a condition where extensive repairs have to be made. You gentlemen have a large part in controlling this avenue of expense.

Good judgment and conscientious regard for duty on the part of the car foremen and car inspectors is of the utmost importance in enabling the railroads to provide satisfactory service to the public, to obtain the maximum use of freight cars and to reduce the operating costs.

A thoroughly practical and smooth working machine is not only expected, it is demanded. Transportation shortage has not been heard of since 1922. This has been possible only by having the whole-hearted support of every individual whose work contributes to the furthering of transportation. The railroads are now in the height of the period of heavy traffic for the current year. That they will handle this peak without attendant shortage of transportation I feel sure, with the same individual effort as we have had from each of you in the past and with your co-operation.

W. T. Westall (N. Y. C.)
President

C. M. Hitch (B. & O.)
First Vice-President

W. P. Elliott (Terminal R. R. Assn.)
Second Vice-President

A. S. Sternberg (Belt Railway Chicago), Secretary

Address by President Westall

The following is an abstract of Mr. Westall's presidential address:

At our annual meeting last October we had a total membership of 246 active members, today we have a total of 564 active members or an increase of 318 over a year ago. Your president does not accept the honor or credit for increasing the membership to this number, but does have the pleasure of congratulating, first, our worthy secretary, Mr. Sternberg, for the hard and untiring work that he has done to bring this about; second, to the chairman of the membership committee, Mr. Elliott, your second vice-president, whom I desire to sincerely thank for the good work he has done in the campaign to secure new members. On Mr. Elliott's

committee there are many whom I desire to thank for the interest they have taken in securing new members, but here I feel it my duty to make special mention of a few, the first is E. R. Campbell, general car foreman, Minneapolis Transfer Railroad, Minneapolis, Minn., who ran way ahead of his ticket and secured 80 new members; W. R. Rogers, chief interchange inspector, Youngstown, Ohio, a close second with 50 members; B. F. Jamison, special traveling auditor, Southern, Meridian, Miss., 32 members; J. A. Roberts, chief A. R. A. clerk, Chesapeake & Ohio, Richmond, Va., 20 members; Mr. Sternberg, with all of his other duties found time to bring in 30 new members.

Your association today stands on solid ground and is recognized by almost all of our high officers together with the American Railway Association. At each convention it brings in new members and associates, as when anyone first attends they are usually anxious to come back each year, and there is no reason now why this should not be one of the largest associations in America. This can be brought about by each member taking an interest in it and bring in at least one new member on or before our 1925 convention.

I hope the young men here will take the opportunity of entering into the discussions of the several papers which will be presented. All of them are very interesting and instructive. Do not be timid in getting up and expressing your views.

Here, I would like to call your attention to Article 6 of our Constitution and By-laws which reads, "No member shall speak more than twice on the discussion of any question until all members have had an opportunity to speak." I feel that in fairness to the younger members, we should give them an opportunity to express their views, but I hope you will all feel free to enter into discussion without being called upon by the chair.

Your president believes the time is now here when a change in our present By-laws should be made by providing a third vice-president, in order that that officer may advance to the office of second vice-president and then to president so that he will become more familiar with the duties of the president when elected to that office. Second: That due consideration be given to an increase in the salary of the secretary and treasurer in order that it be made more attractive and recompense that officer more in line with the attendant work. As I have been in touch with Secretary Sternberg much in the last year, I know that the volume of work that he has handled is not appreciated by many of us. I feel that the association now can well afford to double the salary and I hope you will give this matter due consideration before the convention adjourns.

Work That Can Be Done

Much can be done by all of us after attending these annual meetings by returning home and correcting or putting into effect the conclusions reached. I would here like to call your attention to a recent decision rendered by the United States Supreme Court in which action was brought against one of our large trunk lines for hauling "Cars with Defective Power Brakes after Passing a Repair Station." A synopsis of this case was as follows:

In an action by the government against the railroad company for penalties under the federal Safety Appliance Act, the Circuit Court of Appeals, Third Circuit, certified to the Supreme Court of the United States the following question of law: "May an interstate carrier lawfully operate a car equipped with power brakes past an available repair station to destination when its power brakes, becoming out of order in transit, have been cut out of the power brake system of the train and when more than 85 per cent of the cars of the train are equipped with power brakes controlled by the engineer of the locomotive?"

The Supreme Court answered: "No, unless placed in the train in the rear of all cars having their brakes operated by the engineer."

This decision means nothing else than that all trains passing an inspection or repair point must have their brakes cut in and operating, although the point in question at which the decision was made, was not even considered an inspection point. No regular force of inspectors was employed, although a repair shop was located adjacent or near the train yard. It was considered simply a terminal point for change of engine and train crews, the same engines departing with the trains which hauled them in.

I am simply mentioning this case to point out the need of closer attention to our air brake equipment in order that further action will not be brought against the American railroads. You are the men behind the gun and you can do considerable to bring about an improvement in the maintenance of our air brake equipment.

On this same question I desire to direct your attention to the recent air brake investigation made by the Interstate Commerce Commission which is reported in the *Railway Mechanical Engineer*, September, 1924, in which Commissioner McManamy brings out evidence showing the need for better maintenance of power brake systems. Improved performance will result therefrom, it being the consensus of opinion of the witnesses who testified at these hearings that the present freight brake equipment with "K" type triple is adequate if properly maintained. So you appreciate members that this question now is a very important one and it is our duty to bring about a better maintenance of our air brake systems or have legislation brought about compelling radical changes in our present systems.

A. R. A. Car Repair Billing

By B. F. Jamison

Special Traveling Auditor, Southern, Meriden, Miss.

Never before in the history of the operation of railroads was there the evidence of interest in A. R. A. car repair billing as now. In fact, until a few years ago, little attention was paid to the subject by any others than those directly handling it, who in many cases had little opportunity to study the business. As a result few persons realized the importance of the work which was performed with little regard to accurate accounting.

Of late years, owing to the interest being taken by higher officials of the different railroads, the rules have been extended and enlarged to cover more perfectly car repairs and the accounting therefor. Today we find that car repair billing has become a system of records and accounting, the equal of that employed in any other of the various departments of railroad work and operation.

We have just said that car repair billing has become a system, and this is true. I would like to impress upon you just here that system must be employed in this work, and unless you do have system, you can never expect to have anything like accuracy or to comply with the A. R. A. rules of the present day.

Present Rules Highly Effective

After 27 years of study of the A. R. A. rules and the daily application of them I am glad to say that I am better pleased with our present rules, than ever before, as they more perfectly and justly cover all conditions and situations than in the past.

Recognizing the need of greater care and the adoption of system in the work of car inspection, repairs and billing therefor, the American Railway Association adopted the present Rule 6 of the 1923 Code which refers to "Regulations Governing Inspection and Repairs of Foreign Cars and Billing therefor under the A. R. A. Rules of Inter-

change." This specifies the methods of recording, inspection and repairs of cars and billing therefor, as well as the filing of such records, and, further, that this work shall be in accordance with these regulations.

The adoption of these regulations is the most forward step of the A. R. A. in many years towards bringing about a system of just, honest and accurate car repair billing, on and between the various railroads, members of the association. There is need of careful study of these regulations, testing out your own system, to see if your railroad is complying therewith. If you are not doing so, then you are not keeping up with the progress being made by other roads in the subject of this paper.

If you have not already put system into your car repair billing, then you should do so at once, and, having adopted a system, see that it is carried out in all its details. This and this only will insure your getting results in the work.

Car Foremen Vitally Interested

There has been a practice on the part of many car foremen to leave all matters concerning car repair billing to the A. R. A. clerks, allowing other matters to occupy their full attention and in many cases interest as well. Just a short time ago, I was speaking before a body of men by invitation, and previous to the meeting was introduced to a car foreman with the statement that I was to speak to them on "A. R. A. Car Repair Billing." This car foreman greeted me with the statement—"Well, I think there will be a number of A. R. A. clerks present tonight, and I am sure your talk will be very interesting to them." Now gentlemen, I want to ask you—Why more interesting to them than to him? I am just wondering who here today are most interested in my paper, the A. R. A. clerks or the car foremen?

I submit to you, the statement that there is no knowledge more necessary to the successful car foreman than that of the rules governing billing for the repairs to foreign cars, carding for improper repairs, correcting improper repairs on both foreign and home cars and repairs made on authority of defect card, for without this he cannot properly plan or supervise the work of car repairs.

Often the question has been asked, to name the rules governing car repair billing. All of the rules to a greater or less extent in some manner effect the handling of car repair billing, therefore, it is necessary for a person handling this work to have a knowledge of all the rules.

The Personnel of the System

We will now consider the requirements of the various persons, who have in their order, the responsibility of executing the system of car repair billing.

The Car Inspector—Whether on interchange, train yards or at freight houses and loading stations, it becomes necessary that he shall make minor repairs to cars, and it is his duty to make correctly an original record of these repairs, according to the rules, in order that where a bill is in order, it can be prepared, or where no bill is in order, that the records will clearly indicate the fact.

All material used by him must be properly described according to the descriptions in Rule 101, with such additional information as affect the charges. For example, if an angle cock is applied, it must be shown if the "self-locking handle type" was applied, and if the same type or plain handle was removed, in order to arrive at the correct charge. The reason for repairs must be shown, to determine if any charge is due against the car owner, or if it is a handling line responsibility. In the case of repairs made necessary on account of damage caused by Rule 32 conditions, the fact must be clearly shown on the original record. The location of repairs must also be shown, according to Rule 14.

It is necessary in many cases that information, shall be shown as to the manner of the application of material, such as the number of bolts, nuts, lag screws or pins and cotters removed and replaced in order to enable the person preparing the billing repair card to apply the correct labor charges.

Where the rules provide for a different charge for new or second-hand material or no charge, unless new material is used, it is also necessary that material shall be shown as new or second-hand.

It must now be clear that the car inspector in order to perform this part of his work, must not only be familiar with the parts of cars, but also with the descriptions of material as used in the rules as well. He must be acquainted with the labor allowances for the various operations usually performed by him, as given in Rules 107 and 111.

Nicknames no matter how common should not be used in making original records; for example, "staybolt nut" for column bolt nut, "lock pin" for knuckle lock, "brake idler" for brake lever guide, "hog rod" for body truss rod, etc.

When the car inspector finds repairs necessary, which require that a car be sent to the shop or repair tracks, it then becomes his duty to make careful inspection of the car and apply a "Bad order card" which should show the following information: Date and hour shopped, with inspector's signature or initial; train number in which received, place or location found; principal defects for which shopped, with location according to Rule 14.

Where damage was caused by any of the conditions set forth in Rule 32, this information must be shown. The bad order card should then be securely attached to the car in order that it will remain there until such time as removed by an authorized person. Where various tracks are provided for different classes of repairs, the bad order card should in some manner indicate the track to which it should be switched.

When cars are received in trains with missing material, such as draft gear or side doors, the car inspector should endeavor to obtain from the train crew where this material was left, or the car picked up, and show this information on his original record of the shopping of the car, for the information of the car foreman.

When cars are received in trains showing damage to have been caused by unfair usage the car inspector should obtain information from train crew and show it on the original record of shopping of the car, for the information of the car foreman and work inspector.

The car inspector should then make his original record (preferably on a loose leaf form) of the shopping of the car, which form should show all the information required on the bad order card with the additional information as to the shop, track, or point to which it is ordered for repairs.

Should derailment or any other accident occur while he is on duty, the car inspector should make a full and complete report on a form provided.

The original records of all repairs made by him, with the original record of all cars shopped, and reports of any yard accidents occuring, should be sent to the car foreman's office before the car inspector goes off duty.

The Car Foreman—On the arrival of shopped cars at repair tracks or shops they should be carefully inspected by the car foreman, preferably with the assistance of the work inspector, or person whose duty is to make the original record of repairs made, often called the "Write up man." When it is decided what repairs are to be made, they are recorded by the car foreman or work inspector on the original record of repairs form, loose leaf form preferred.

In authorizing repairs to be made, the car foreman should see that only proper repairs are made. In order to do this he must be familiar with the latest A. R. A. standards and recommended practice and understand the requirements of the rules, especially Rules 17, 87 and 88. He should know what material he has in stock, and in case he has not

the proper material to make repairs, he should take immediate steps to obtain it and if necessary order it from the car owner, doing so in accordance with Rule 122 immediately, in order that there be no unnecessary expense of per diem. Many car foremen hesitate to incur the expense of a few days per diem, while not hesitating to incur a much greater expense in assuming the liability for making improper repairs.

The file of accident reports, should at all times be accessible to the car foreman and work inspector, and whenever the appearance of damage indicates a possible accident, should be referred to in order that the proper action may be taken as to handling the repairs and making the original record of same. All original records should be preceded by the words "Bill owner" or "No bill."

The car foreman should, when it is necessary to make improper repairs, check them carefully and issue his company an A. R. A. defect card, attaching it securely to the car before the car is marked O. K. to pull. A knowledge of the provisions of Rules 17, 87 and 88 are particularly necessary to do this correctly.

Temporary repairs should only be made as a last resort. It has been my experience that often, as much material and labor has been consumed in making temporary repairs as would have been required to make proper repairs, the result of which was a direct loss, as no bill can be rendered.

As the car foreman's signature is required to the original record of repairs, it will be plain that he must at all times be familiar with this part of the working of the system.

The Work Inspector—The preparation of the original record of repairs made by small repair forces is usually done by the car foreman in charge, while in larger places a regular man is assigned to this work whom I call the "work inspector." In order that your original records shall be correct in all the details necessary to render your bills perfectly, it is necessary that the person intrusted with this work shall be familiar with the A. R. A. rules of interchange and regulations referred to in Rule 6.

By all means, he should write a plain hand, easily and quickly read and not mistaken. In order that he will give the proper description of material used, he must be well acquainted with the construction of cars, keep posted as to the ever-increasing improvements adopted and in use on foreign cars, use terms and descriptions as shown in the rules in applying material listed therein.

The making of the original record of repairs is perhaps the most important of all the parts of the system of car repair billing. Therefore it follows that the person intrusted with this work must be an experienced man, must make the original record directly at the car, and not from memorandum taken down by some one else or himself in a book or otherwise. The loose leaf form is much the best for the original record. All information required for the preparation of the billing repair card must be shown. The weights of such items as can be calculated from the A. R. A. scale of weights, issued Feb. 20, 1922, Circular DV-226 need not be shown, the weight of all other items charged by weight should be actual scale weight and not estimated. Board feet of lumber need not be shown, but correct dimensions must be given, using the finished size for all dressed or matched stock, and, where the lumber used is rough, the original record must show "rough" following the dimensions.

In the description of material used, great care must be taken to give the correct information. In Rule 101 the various prices shown for the different materials and articles vary as to the type, size or composition of the material or articles. Common errors occur in the description of triple valves, pressure retaining valves, angle cocks, couplers, and brake beams, it being necessary to show in all these cases not only the kind applied, but that removed also, in order that the correct charge may be made by the A. R. A. clerk on the billing repair card. To describe material simply as "steel" is not sufficient, for a different price is given for cast steel, plate (or sheet) steel, pressed and flanged steel which is plate steel formed into certain shapes required, fabricated pressed and flanged steel which is two or more pieces of this material riveted together to form a certain part or article, and then composite fabricated which is pressed and flanged steel to which or with which other metals are combined with rivets. The word "fabrication" does not apply to the rivets used in applying parts to cars, but to the shop construction of parts. When A. R. A. standard material is substituted for non-standard material, both articles must be clearly described. Where material has been received on requisition from car owners, this information must also be shown on original records in order that the invoice price and freight charges may be obtained, for the billing repair card. Great care must be used in the description of manufactured articles covered by Rule 105. The name of the article used by the manufacturer should be used in order that the correct store room or factory cost may be obtained. Considerable difficulty has been experienced in this line. Personally I learned much by a study of the various advertisements of the numerous railway appliance companies in the current publications such as the *Railway Mechanical Engineer*. I would like to see more illustrations of these patented devices in the advertisements, contained in our annual proceedings. It would be of a wonderful benefit to those who must know the proper names.

It is necessary that the work inspector shall study and memorize the various operations shown in Rules 107 and 111 in order that he can make his records in the proper order with relationship of one item to another.

Showing the major repairs for which a specified labor allowance is given in the rules, with the associated items following, will prevent many of the errors in labor charges on billing repair cards. The increasing number of operations which are on the bolt, nut, lag or rivets basis make it necessary that this class of material follow the parts used in connection, in order that labor charges may be made correctly. The purpose for which bolts, nuts, lags or rivets are used should be shown by giving them the name of the part, column bolt, carrier iron nut, pipe hanger lag, sill step rivet, etc.

In many cases the labor for certain items of repairs are included in the charge allowed for other repairs, making it necessary that these associated items be recorded in groups. It therefore becomes highly necessary that the work inspector be familiar with these combinations as shown in Rule 107, many of which require close study.

Where cars repaired have been damaged in accident, reference to the accident report should be made on the original record of repairs, showing the date or number.

Where repairs have been made on the authority of a defect card, the original record should clearly show this, with the railroad, date and number of defect card, place and inspector shown, followed by the repairs made. Partial repairs should be handled according to Rule 5.

The correction of improper repairs on home cars, covered by report of improper repairs should show in the same manner.

The correction of improper repairs on foreign cars, should be made with great care, and records must clearly show not only how repairs were made but the reason for them, with a description of the improper parts, in order that when the car owner receives the repair card there will be no difficulty in handling according to Rule 90.

Where improper repairs are made, the original record must show the number and date of the defect card attached to car to cover same.

The work inspector must be a capable man. I submit to

you that he must be a studious man, one who carries his rule book with him, and one who sees each day's setting sun bring him one more fact or truth in regard to his important work.

Weigh masters' certificates of light weighing of cars, when checked by the painter and signed by him indicating that he has re-stencilled them, become original records for the preparation of billing repair cards.

Repairs made by train crews are to be reported on a form provided for the purpose, and such forms become the original record for the preparation of billing repair cards. Care should be taken to educate train crews to provide correct information as to material and repairs made by them.

Derrick Foreman—The majority of accident reports are prepared usually by the derrick foreman (although many are prepared by car inspectors, freight train conductors and engineers).

It is necessary for the derrick foreman to understand the A. R. A. rules, in order to make his reports of damage to cars properly. Care should be taken to show the real cause of accident, using as far as possible the terms shown in Rule 32. It is also necessary that the derrick foreman understand the application of Rule 112.

Derrick foremen can be of great assistance to car foremen in the handling of material belonging to cars which will be brought to shops. Many times certain cars are destroyed while others with missing draft gear and other parts are loaded and brought to shops and repaired. All such parts should also be loaded and tagged and shipped to the shop with the car. This may require a little valuable time, but it will more than save the expense in the saving of material and delay in repairs.

Each car sent to the shops should bear a bad order card giving information concerning the accident, where, and when damaged, and signed by the derrick foreman.

All accident reports, when received at the car foreman's office should be filed as nearly as possible in date order and numbered consecutively. Where billing repair cards are prepared in other than the car foreman's office, a copy of all accident reports should be furnished the A. R. A. clerk's desk for use in checking responsibility for repairs.

The A. R. A. Clerk—It is the custom on most roads to designate the person intrusted with the preparation of billing repair cards as the A. R. A. clerk. Much that has been said already in regard to the duties and requirements of the work inspector is also true of this person. In fact, it may be truthfully said that the weaker either of these two are, the relatively stronger the other must be. To express it in other words, if your work inspector has not all the knowledge or experience necessary then it is just to that extent more necessary that your A. R. A. clerk shall have.

It is necessary that the A. R. A. clerk be familiar with the rules governing handling, delivering line responsibility, and owners' defects in order that he shall be able to check up with those who have handled the records thus far, to know that they have made no errors, and that bills may be rendered only for those items of repair for which the owner is responsible. No charge should be made where there is none due. Likewise his company must be protected, where protection is due. Defect cards must be handled correctly and according to the rules.

Billing repair cards should be complete in all details as to net prices, labor allowances, weights and classification of materials, scrap credits, and board feet of lumber, before being forwarded to the general office for billing.

It has been the practice on some lines to leave the work of the extension of these items to the general office, but this is not a good practice, for the reason that there are many conditions, combinations and descriptions of materials and repairs, the need of which will not become apparent to the individual writing billing repair cards, until he attempts to make these extensions.

Billing repair cards should be numbered consecutively in order that none may be lost or misplaced, and should by all means be checked against the original record after it has been issued and before being forwarded to the general office. Where two or more A. R. A. clerks are employed in the same office, it is well that one check the other's work; also any car foreman can easily add much to his fund of knowledge by the practice of checking the work of his A. R. A. clerks.

No information can be assumed by an A. R. A. clerk; no net price, labor allowance or other information should be shown on billing repair card which is not supported by the facts shown on the original records. No additional information should be written on the original record by the A. R. A. clerk, or correction made. When such is necessary he must bring the same to the attention of the work inspector or foreman authorizing the repairs, who will add to or correct records as the case may be.

It will naturally be seen that if these things are expected of the A. R. A. clerk, he must be an experienced man, acquainted with the construction of cars and understanding what materials usually are used for the different parts. If this experience has not been acquired by practice then it must be by close observation and teaching.

He should write a good hand, do his work neatly and keep it up to date at all times, he must be familiar with the net prices, scrap credits, labor allowances and various charges allowed, under the various conditions.

As the A. R. A. clerk's work is the last of the system done in the local or district office, it is plain that much responsibility rests on this man. He should carefully study the exceptions taken to his bills and work by the car owner and correct his weakness and errors in future repair cards, in order to eliminate exceptions.

Handling of Accident Reports Important

All copies of accident reports furnished this desk should be kept in a suspense file for ready reference and as fast as bills are prepared for cars shown thereon, the date of repairs are entered and the reports placed in a permanent file for future reference and checking. If this plan is followed out, it will be readily seen that there need be no mistake made as to the responsibility of repairs. As soon as copy of an accident report is received at the A. R. A. clerk's desk, he should ascertain from the daily car record book if the car has been repaired, if so checking his record repair cards to see how the bill was rendered. If an error is found he must take immediate steps to correct it. Otherwise, he will place it in the suspense file until a bill is prepared and then file it in date or numerical order.

All accident reports should be entered in the daily car record book in red ink or red pencil, in order that ready reference may be made at all times to the accident file. This is a small item of work, but will be found of great benefit at all times in handling correspondence as well as billing repair cards.

The system of billing for car repairs would not be complete if there were not periodical checks made by inspectors or auditors. These persons should check the repairs actually made on the cars with the original records during their visit to shops and check various periods of repair cards against the original records on file. Make a report to the proper officials after the exceptions taken have been explained to these concerned and leave a copy at the point checked.

In conclusion I wish to say, that the adoption and execution of a system or plan as outlined cannot be accomplished in a day. It must be the result of an earnest continued effort on the part of all concerned and be adopted by all divisions until the entire road is following the practice.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged by a Sudden Train Stop

The American Refrigerator Transit Company's car No. 9466 was damaged while being handled in a train on the lines of the Denver & Rio Grande Western at Echo, Col., August 22, 1921. Both end sills, the two intermediate sills, the two side sills and a portion of the siding and flooring were broken. At the time of the accident the car was empty and was reported to be the sixty-seventh car from the head end of a train of 73 cars. This train was being handled by two engines, one ahead and one on the rear end. As it was being pulled out of a passing track, the brakeman's key caught in the switch lock, and the delay in throwing the switch caused the engineman to make a sudden stop which resulted in the damage to the car. As the result of an inspection made by the car foreman of the Denver & Rio Grande Western, it was decided that the damage was due to weak construction and the handling line submitted an inspection certificate to the American Refrigerator Transit Company in accordance with Rules 43 and 120. The owners claimed, however, that this was a case of damage caused by a misplaced switch which is chargeable to the handling line according to Rule 32, and requested that the handling line either repair the car, or make settlement according to the rules. The handling line, however, contended that the strain to which this car had been subjected, was no more severe on this occasion than it would have been had an emergency stop been made or an air hose burst.

The following decision was rendered by the Arbitration Committee: "There are no conditions which bring this car within the provisions of Rule 32. As the car had not passed over the misplaced switch, this precludes the question of a misplaced switch from consideration. Therefore, the car owner is responsible."—*Case No.* 1303, *Denver & Rio Grande Western vs. American Refrigerator Transit Company.*

Damaged Car Is Received in Interchange

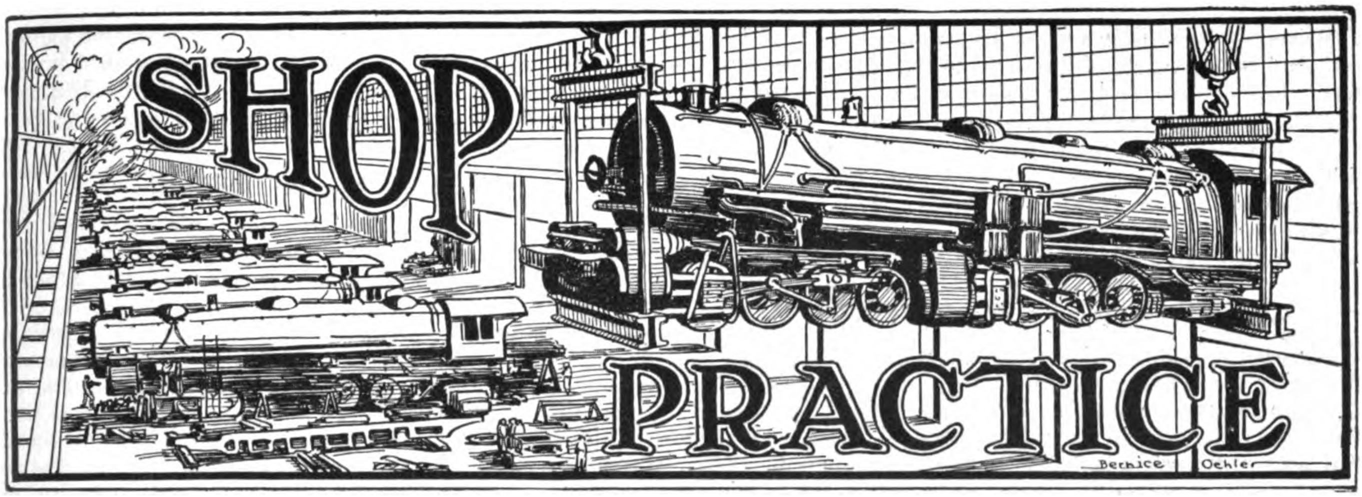
On August 26, 1922, the Indiana Harbor Belt delivered Louisville & Nashville car No. 3131 to the Chicago & North Western at Proviso, Ill., with six longitudinal sills broken near the body bolster. The car was loaded with automobile lamps and the receiving line was compelled to move it to its transfer track where the contents were transferred to another car. While attempting to return the damaged car to the Indiana Harbor Belt, the sills failed entirely and the car collapsed. The Chicago & North Western advised the Indiana Harbor Belt the condition of the car and requested it to handle the case direct with the car owner on account of it being complicated with Rule 43. The Indiana Harbor Belt refused to accept the car, stating that it understood according to Rule 43, that the responsibility rested with the company on whose line the car had failed entirely. The Chicago & North Western submitted evidence which showed that the damage exceeded the limits specified in the note under Rule 43 when the car was delivered by the Indiana Harbor Belt. It contended that it should have been advised as to the exact circumstances under which the car was damaged while in the possession of the delivering line and in case of inability to ascertain these facts the delivering line should assume the responsibility for the damage and handle the case direct with the car owner according to Rule 112. The Chicago & North Western contended further that as the Indiana Harbor Belt did not desire to handle the case direct with the car owner, it should have authorized the Chicago & North Western to do so, as well as to counter-bill against the Indiana Harbor Belt for the depreciated value of the car, which developed to be less than it would have cost to make repairs. The Indiana Harbor Belt refused to do this and rather than penalize the car owner, the Chicago & North Western, not being able to obtain the information required under Rule 43, reported the car under Rule 112 and authorized a bill amounting to $421.88, the depreciated value of the car.

The Arbitration Committee decided that the six sills were broken at the time of delivery of the car from the Indiana Harbor Belt to the Chicago & North Western, and that the Indiana Harbor Belt, failing to furnish a statement showing the circumstances as to whether the damage had occurred in fair usage, according to the foot note to Rule 43, should, therefore, assume the responsibility.—*Case No.* 1305, *Chicago & North Western vs. Indiana Harbor Belt.*

Car Damaged in Hump Switching

Louisville & Nashville box car No. 91415, with a stenciled capacity of 65,000 lb. and of all wood construction, built June, 1905, was damaged in hump switching service, November 13, 1922, on the New York Central. A disposition was requested under Rule 120 for labor costs of $365 and material costs of $350. The circumstances under which the car was damaged are as follows: The brakeman handled a cut of three cars over a hump. He set the brake of the first car and proceeded to the second car to set the brake but found that the brake chain was too long and then proceeded to set the brake on the third car. The cut of cars struck the Louisville & Nashville car which stood first on the track to which the cut was switched and the impact caused the damage. None of the cars involved were derailed, cornered or sideswiped. The car owner contended that the rider lost control of the movement of the cars and requested settlement under Rule 112 while the New York Central contended that the car was not damaged under any of the provisions of Rule 32 and that the damage was, therefore, owner's responsibility. The New York Central in defending its position, stated that Section (c), Rule 120, provides that the owner shall authorize repairs or destruction of the car within 30 days from the date of notification. As no advice had been received from the owner within 30 days, and as the car occupied much needed track room, the handling line issued instructions to dismantle the car. The Louisville & Nashville stated that after reviewing the joint inspection certificate as well as the explanation of how the damage occurred, it was of the opinion that it was a clear case of unfair usage under Rule 32, Paragraph D, Section 3, and requested the handling line on December 11, 1922, to assume responsibility and settle for the car in accordance with Rule 112. The owner had intended to send a representative to inspect the car in the event that the New York Central refused to accept responsibility, but held this in abeyance awaiting reply to its letter of December 11, 1922, which it did not receive until March 27, 1923, after a delay of nearly four months. The New York Central then definitely declined to accept responsibility. The owner then communicated its desire to inspect the car but was immediately advised that the car had already been dismantled. Upon receipt of this information the owner requested that the car be settled for under Rule 112.

The Arbitration Committee decided that the car was not damaged within provisions of Rule 32 and disposition should be furnished under Rule 120.—*Case No.* 1307, *New York Central vs. Louisville & Nashville.*



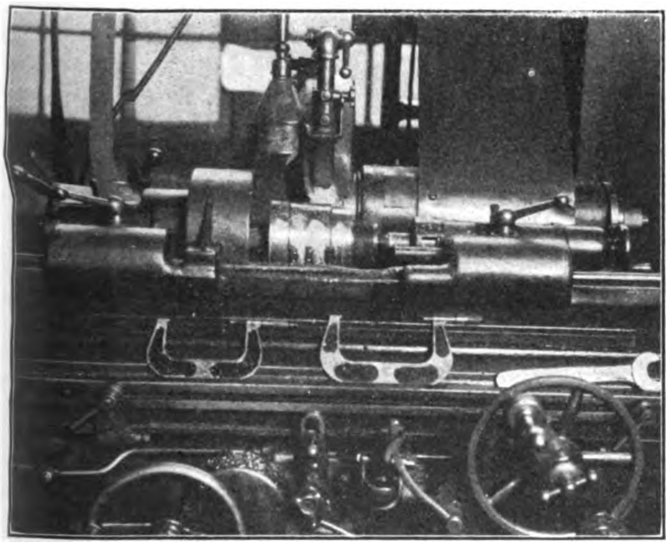
Application of Micrometers in Railway Shops*

Interchangeability of Pins and Bushings for Valve Motion Is Made Possible by the Use of Micrometers

Part III

By M. H. Williams

WHEN repairing locomotives it is important that the distance from the centers of driver axles and also the distance from the center of side rod brasses be correct. Measuring these tram distances or setting adjustable tram points with or from a rule, scale or tape line is entirely possible and often done with complete success. There is, however, the possibility of errors owing to the lack of proper knowledge of the correct center measurements, defective rules, etc. There is a further chance for error when one part of the work is done in one department and the remainder in another, such as the erecting shop and rod shop. This is mainly due to the lack of a uniform standard, and, in the event of errors, it is difficult to tell who is at fault. With proper measuring appliances such as the tram bar a convenient and accurate master standard is available, making it entirely practical to lay off the driver box shoes and wedges independent of the rod work with the assurance that each department will use identical measurements.



Outside Micrometers Are Used When Grinding Knuckle Pins to Fit the Rods

Tram Bar

A tram bar used for setting the adjustable points for laying off rod centers, laying off shoes and wedges, setting and proving distances between axle centers, etc., is shown in Fig. 1, and may be considered a master standard for this purpose. The tram bar shown may be made of 2-in. by ½-in. steel about 8 ft. long. Hardened steel bushings about ¼ in. in outside diameter with a 1/16-in. hole drilled in the center about ¼ in. deep are set in this bar at proper locations. These are used as gage points when setting adjustable trams. At A is shown the zero bushing that is always used as one of the setting points; the remaining bushings as shown at *B, C,* etc., are located a distance from the zero point equal to the standard distance, center to center, of rod sections. The class of locomotive and rod section are stamped on the bar near the bushings for the purpose of indicating them. For example, if locomotives known as 2-8-2-A require a distance of 54 in. for the front section of the rod, the bar is stamped "2-8-2-A FRONT" at this place. Another for an intermediate section may be distant 58 in. and stamped "2-8-2-A INT.," and so on.

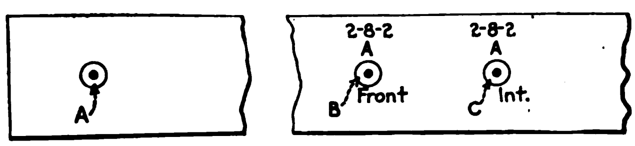


Fig. 1—Tram Bar for Setting the Adjustable Points for Laying Off Rod Centers

These bars are permanently fastened on walls, benches or other convenient locations in the erecting shop and rod shop.

* This is the final of a series of three articles. For the preceding articles, see the *Railway Mechanical Engineer* for August, page 481, and September, page 553.

The men, when setting adjustable trams, go to these locations and set the points of the trams to the holes in the bushings. Two or three will generally meet the requirements.

These tram bars afford ready and accurate means for setting the adjustable trams and also remove many possibilities of errors when laying off rods, shoes and wedges, or axle centers, because both the erecting and rod shops are working to the same standards. In case of an error, they are referred to as a master standard.

Measuring Side Rod Bushings

Micrometers calipers have proved very satisfactory for measuring the diameter of crank pins, the bore of side rods and both the outside and inside of rod bushings. In several shops it is the practice to measure the diameter of crank pins with micrometers both for the purpose of judging as to the necessity of refinishing and also to obtain the required size for boring the side rod brasses. This work is performed at the same time and in a manner similar to that of inspecting driver axles. The diameters or crank pins are, at this time, recorded on blanks and handed to the workmen whose duties are to bore the rod brasses. When boring the brasses, they are made a predetermined amount larger than the crank pins to allow for the required running fit between the two, and, while no definite amount is recommended, it is believed that the brasses should be about .002 in. per inch of diameter larger than the crank pins when the latter, if out of round, are measured at their largest diameter. Thus, for a 6-in. crank pin, the brass should be bored 6.012 in.; for a 7-in. crank pin the brass should be bored 7.014 in. etc. The use of micrometers which tend to insure accurate measurements combined with the records of road service will, in time, supply data from which the amount that should be allowed for a running fit between the pin and brass can be decided for all classes of power.

The more progressive method of boring rod brasses either before or after forcing into rods is to make use of adjustable boring bars equipped with micrometer dials similar to those described in connection with boring car wheels. Where the crank pin sizes are recorded in decimals on blanks the man finishing the brasses bores them a specified amount larger than the pins and, as a result, need not leave his station for the purpose of taking sizes of crank pins. This results in a greater output of the machine and also the blanks become a record which, in the event of an error or a defective bearing, may be referred to. If the defective bearing is due to a man failure the blame can be placed where it belongs, or if the road records are not satisfactory, the amount that should be allowed for a running fit can be modified. This tends to solve the troublesome question as to the amount that should be allowed for a running fit. The use of micrometers will gradually reduce this question to an exact science and result in the elimination of the personal equation such as follows when measuring crank pins with machinists' calipers. One of the greatest advantages from the use of micrometers follows when men, unaccustomed to this work, are called upon to bore rod brasses from printed instructions which specify the amount the brasses should be larger than the pins. The possibilities of errors are reduced to that of machine work or measuring, thus eliminating the necessity of a new man estimating the amount that should be allowed.

The inside micrometers similar to that used for car wheels are very satisfactory for measuring the diameter of the bore of side rods. By their use the rod bore is quickly measured at different angles, and in the event of the bore being out of round an excessive amount, the rods can be set aside for reboring. If the average diameter is found to be within the required limits, the outside of the rod brass is turned a definite number of thousandths of an inch larger than the rod bore. The outside micrometers are used in this operation. When fitting side rod brasses the amount the brasses should be larger than the rod bore can be governed by the use of micrometers by definite instruction which will reduce the possibility of brasses being turned too large and thus straining the rods or, if turned too small, coming loose.

Knuckle Pins and Bushings

Inside and outside micrometers are used to good advantage when fitting side rod knuckle pin bushings. The measuring is similar to that used in connection with fitting side rods brasses.

When fitting pins to knuckle pin bushings, it is generally considered desirable to allow a small amount of lost motion between the two, which may vary from .004 in. to .008 in., according to the class of service, individual judgment, etc. It is important that the lost motion shall not be too small where there would be the possibility of insufficient play to admit of weaving of the joints between the rod sections when the locomotive is rounding curves and likewise not too great an amount which may admit of the rods knocking. Micrometers are used to good advantage when fitting these two parts together. One practice is to measure the bore of the bushings after pressing them in the rods, and then grind or turn the pins the specified amount smaller than the diameter. This practice generally results in quick and accurate fitting. Another practice requiring close measurements is at the time of manufacture to grind the bore of bushings to plug gages and pin bearing surfaces to exact diameters and place in stock. Having the bore of the bushings and the body of the pins finished greatly reduces the time required for repairs. This practice is worthy of serious consideration owing to the economy of production grinding as compared with fitting each part separately. It, however, has certain drawbacks such as the necessity of true and cylindrical holes in the rods into which the bushings are to be pressed owing to any

Measuring the Bore of a Side Rod Brass with An Inside Micrometer

irregularity of the rod hole being reflected in the bore of the bushing after it has been forced into the rod. A certain allowance must also be made for the compression of bushings when pressing into place.

When fitting with tapered ends of knuckle pins to side rods the flat tapered gage shown in Fig. 2 is of great assistance. It is about 1/4 in. thick, accurately ground on the edges to the same taper per foot as the reaming of side rods. One edge is graduated and stamped similar to a rule or scale to indicate the actual diameters at the graduations. When measuring the diameter of a taper hole in side rods or testing the accuracy of the reaming, the gage is placed in the rod as shown and given a slight turn which centers it. The

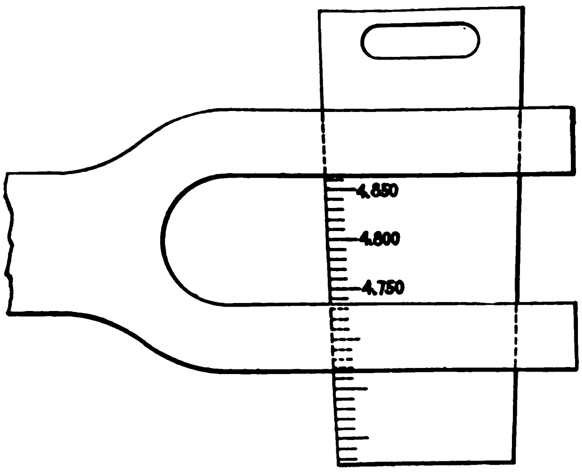


Fig. 2—Taper Gage for Knuckle Pin Holes

diameter is then read at the inside of the smaller jaw. When grinding or turning the knuckle pins, its diameter at this point is finished to the same diameter plus the amount that should be allowed for a drive fit. During this operation the pin is measured with a micrometer as shown in Fig. 3. When this surface of the pin is to the correct size, the in-feed position of the grinding machine or lathe tool is noted or set. The larger end of the pin is then finished from the same setting which makes it evident that with the taper of the grinder or of the lathe properly set, the two ends of the pin will be finished to the required taper per foot, providing the grinder or lathe tool is, in either case, fed in the same amount as would follow were the taper continuous from end to end of the pin.

This gage has the advantage of light weight, ease of application, and acts as a check on the accuracy of the reaming of rod jaws. By its use in connection with micrometers, semi-finished knuckle pins are readily ground on the two taper ends to a rod fit in less than 10 minutes.

Measuring Main and Side Rods

In past years it has been the practice, when fitting in main rod brasses, to file or chip and make several trial fittings of the brasses before they were finished to the correct size. This was considered satisfactory for the light weight brasses formerly used. Today the brasses have become so heavy that the necessity of lifting them several times before a satisfactory fit is obtained should be avoided when possible. What has been said relative to the measuring crank pins and the bore of side rod brasses also applies to the bore of main rod brasses.

In some of the modern railway shops, when fitting either the front or rear main rod brass considerable time is saved by finishing the brass by machining to the correct sizes. In order to accomplish this desired result it is necessary to measure the parts accurately with micrometers. One good practice is to measure the jaw space with inside micrometers such as shown in Fig. 4. When making use of this instrument the base *A* is placed on one jaw, which sets the micrometer square with the jaw. The width of the jaw is then measured simply by turning the micrometer screw. The micrometer is then moved to other locations and measurements read in order to detect such errors as may exist in the width of the jaw.

Just how much variation should be allowed in the distance between the two sides of the jaw or strap of a single rod is an open question. When the jaws are repaired by milling or slotting it is not difficult to true these surfaces so that the measurements will agree within a limit of .003 in. Where the jaws are filed it becomes a question of the amount of time that should be allowed or what is considered good enough to meet the requirements. This method of measuring makes it entirely practical to set limits for the work, and as the measurements are quickly made, the workman, when refinishing the jaw, frequently makes measurements as the work progresses. The effect is that when truing the jaws either on a machine or by filing, he knows the degree of accuracy demanded and finishes accordingly.

After the jaws and the sides of rods are finished in a satisfactory manner, the width of jaw and thickness of the rod is measured and a memorandum made of it for the benefit of the man finishing the rod brasses.

In a number of shops rod brasses are finished on planers, slotters or milling machines to the exact size required to fit the rod jaws which results in the elimination of practically all filing and the laborious operation of making the several trial fits previously mentioned. The practice, when machining, is to finish the surfaces to fit and rod jaws .002 in. or .003 in. less from surface to surface than the jaw opening. The distance between the flanges of the brasses are finished about the same amount wider than the rods. These distances, during the machine operations, are measured with micrometers. To finish rod brasses so that, as they come from the machine, they will fit the rods without hand work requires a high grade of machine work and close measuring. This is difficult to accomplish without the use of micrometers, and while this manner of finishing as compared to semi-

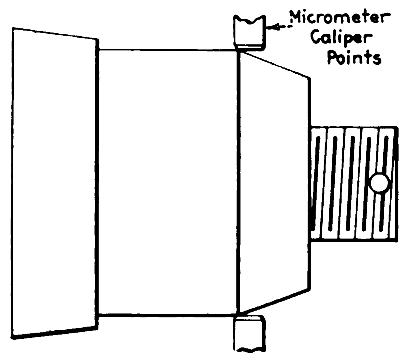


Fig. 3—Callipering a Knuckle Pin

finishing may add to the cost of the machine work, there is a substantial saving as a whole owing to the elimination of hand work. The character of the fit of brasses to the rods is as a general proposition greatly improved.

Gages for Valve Motion Levers

By careful planning and with the proper facilities, the bearing surfaces of pins and bushings such as used in valve motion levers are readily made to interchange with each other, and, as a result, the companion levers for each class may be shifted from one locomotive to another with the assurance that they will fit in a satisfactory manner. As an example, the bushings used in the lap and lead levers for any one class of locomotives are fitted with bushings having their inner bearing surfaces finished to plug gages. The companion

levers are fitted with pins having bearing surfaces which are finished a trifle smaller by the use of external gages or micrometers. In other words, each bearing surface is finished to a gage or micrometer, which, therefore, becomes a substitute for the practice often followed of fitting the pins and bushings to each other for each individual pair of levers. Finishing parts in this manner admits of quantity production where the bearings are finished in large lots. In addition there is a decided saving in time when repairing the levers.

A practice followed in some shops is to bore, ream or grind the internal bearing surfaces of the bushings to plug gage sizes within a limit of .001 in., the outside of the bushings being only rough turned. The external bearing surfaces of the pins are finished to external gages or micrometers to a limit of .001 in. the ends being rough machined. It is, of course, necessary when determining upon the sizes for these bearing surfaces to make allowances for the running fit between the two. Good practice appears to indicate that the allowance for running fit should be between .005 in. and .006 in. In addition, allowances must be made for the compression of the bushing resulting from pressing it in the lever. This compression may possibly amount to .002 in., and under these conditions the pins at the time of finishing should be about .008 in. smaller than the bushings. As an example, for 2-in. bushings, the pins should be 1.992 in. in diameter. It is not within the scope of this article to go into the question of the various step sizes that are necessary to meet all conditions of repaired valve motion levers. The use of plug gages, external gages and micrometers, however, have made it a simple every day proposition in railway shops to finish these bearing surfaces to the limits of accuracy desired.

Fitting Bushings to Valve Motion Levers

At the time of making repairs, the holes for the bushings in valve motion levers generally vary to such an extent that any attempt to make use of bushings previously finished to

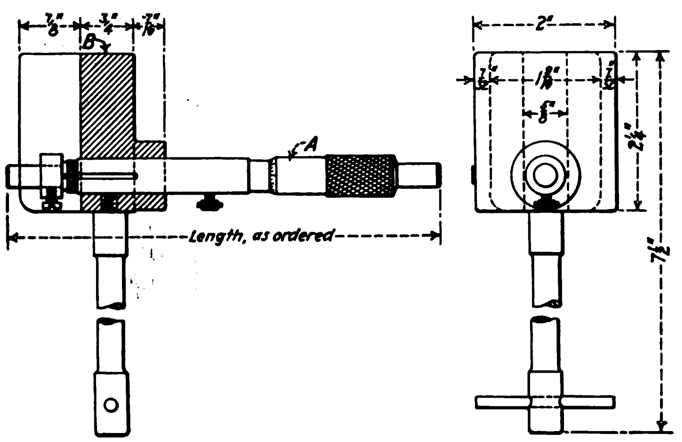


Fig. 4—Inside Micrometer Callipers with Special Attachments for Measuring the Front or Rear Main Rod Jaw Space When Renewing Brasses

pre-determined outside sizes does not appear practical. It is, therefore, necessary to machine each individual bushing for each particular lever, which is best performed on plain cylindrical grinders. The time required for fitting each bushing to the levers is governed to a more or less extent by the time taken when making measurements. To measure the small holes in these levers with inside micrometers or machinist's calipers is a somewhat slow operation. In order to reduce this time, good use has been made of the sliding gage shown in Fig. 5 which is made up of triangles *A* and *B*, held together in a suitable manner. The edges *F F* that fit the bushing are ground to about a 1-inch radius. The projection *C* is to prevent the triangle *B* from entering the hole.

In operation, the gage is placed in the hole, where the projection *C* comes flush with the side of the lever as shown at *D*. The triangle *A* is now moved forward until the gage is tight in the hole. It is evident that under this condition the combined distance over the triangles *A* and *B* or the surfaces *F F* will be the same as the diameter of the hole and that micrometer measurements as shown at *E* will give the true diameter of the hole. With this gage and micrometers, these holes are accurately measured in a few seconds.

When grinding the bushing, their diameter is measured with the same micrometer used on the gage. The practice is to grind the bushing until it shows a true surface, then measure the diameter, this reading showing the reduction in size necessary in order to obtain the desired diameter, i. e.,

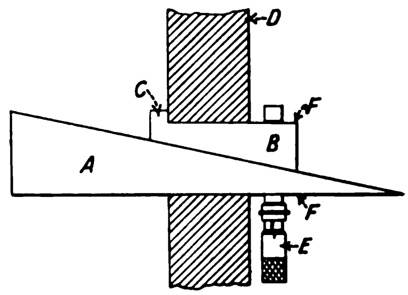


Fig. 5—Sliding Gage Used to Measure Small Holes in Valve Motion Levers

the number of thousandths the wheel must be fed into the work. The amount the wheel is fed is gaged by the micrometer dial on the machine. A person accustomed to the work, after making the first reading, subtracts the desired diameter from this reading and sets the amount on the machine dial and grinds until the bushing is to the correct size, when a final measurement is made. About 90 per cent of the bushings, when ground in this manner, are to the correct size on the first trial. The bushings are generally ground from .002 in. to .003 in. larger than the hole to allow for a forced fit. With this gage, micrometers and a grinding machine, bushings are readily fitted at the rate of 10 per hour, which includes measuring, grinding and driving into place.

The operation of fitting valve motion pins to levers is very similar to fitting knuckle pins to side rods previously explained. The flat gage shown in Fig. 6 is used for obtaining the sizes of the taper holes. The taper end of pins are ground the same as the knuckle pins. An experienced operator will readily fit from eight to ten pins per hour.

Advantages

The use of gages and micrometers has made it possible and entirely practical to finish the bearing surfaces of valve motion lever pins and bushings in the manufacturing department, where, owing to quantity production, the cost is greatly reduced as compared with finishing each of these surfaces separately at the time of fitting to the levers. At this time it is only necessary to grind the external diameter of the bushings and the taper ends of the pins, and as the time required is greatly reduced, one man generally grinds all of the pins and bushings required for a shop repairing 50 locomotives per month.

One of the greatest advantages is the interchangeability of the pins and bushings. As these parts are each finished to the correct size for a running fit to each other, the levers may be mixed up indiscriminately or shifted from one locomotive to another. In some shops it is the practice to repair the levers in large lots and place them on racks. When they are ready to assemble on the locomotive the various levers are picked at random similar to the practice with interchangeable machinery.

Further Proceedings of Master Blacksmiths

Tools and Formers and Method of Spring Repairing which Were Brought Out at the Meeting

THE International Railway Blacksmiths' Association held its twenty-eighth annual convention at the Hotel Sherman, Chicago, August 19, 20 and 21. A partial account of the proceedings, including the list of officers elected for the coming year, appeared in the September issue of the *Railway Mechanical Engineer*. Abstracts of the reports presented on other subjects discussed at the meeting are given below.

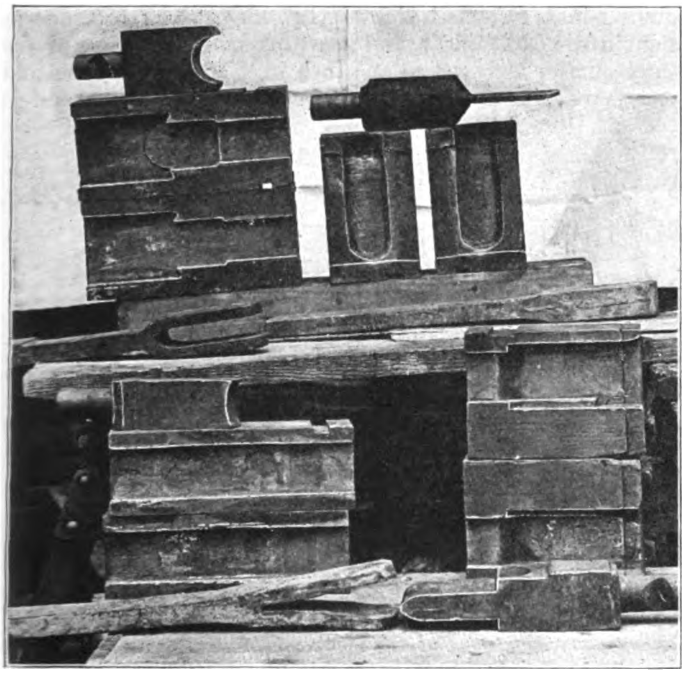
Tools and Formers

By C. A. Slenker

Blacksmith Foreman, Long Island, Richmond Hill, N. Y.

The tool question is an interesting one. Almost every railroad blacksmith shop is to some extent deficient in suitable machinery and the apparent lack of interest in forging machinery and dies is to be regretted. In this direction there is a field for a vast amount of saving in railroad shops.

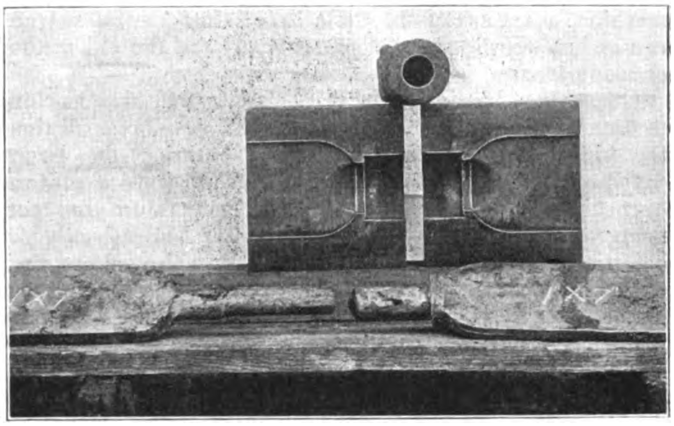
The question today is economy. Does it pay to make a die for a small lot of standard forgings, about 100 a year? I would say it does. First, it is up to the foreman of the smith shop to form an idea of a suitable die. He must then take into consideration just what the job is costing him at the present time adding overhead expense. He must estimate what the cost will aggregate when using the die. When a foreman has acquainted himself with these facts he will be in a good position to go before his superior and submit the cost of the forging. In nine cases out of ten he will get the dies he is after. Success with forging machine dies depends largely on the ability to design our own dies. Several forging machine companies are sending out plates or drawings of different dies which are a great help to a foreman.



Dies Used in Forging Swing Links

Great improvements have been made in forging machines in recent years. One of the illustrations shows a swing link made of solid stock without welds. This link was made on a two-inch Ajax forging machine. The arrangement of the dies and the number of operations will be evident from a study of the illustrations.

The pitfalls of designing forging machine dies are many. Perhaps the greatest is the attempt to gather too much stock in one upset. If we stay within the laws governing forging machine dies, designing the dies so that not more than three times the diameter of the stock will be gathered we shall have no trouble. The second illustration shows dies for 1-in. by 7-in. driver brake beams. These dies are simple but do a good job which is capable of being organized on a production basis because of the large number of brake beams used in railroad service.



Dies for Making Driver Brake Beams

Improved Method of Repairing Springs

By T. F. Buckley

Blacksmith Foreman, Delaware, Lackawanna & Western, Scranton, Pa.

When a locomotive spring comes to the shop for repairs it is first examined for broken plates and, if apparently sound, it is placed under the testing machine. If it fails to meet the required test the band is removed and the plates are gaged for proper thickness, by a gage 1/32 in. short of size. If the plates show this deterioration they are replaced with new or old steel of the proper thickness. The spring is then reassembled and ready for the spring former.

The furnaces should be equipped with pyrometers to insure exact temperatures for the plates before they go to the machine to be formed. The machine used in forming the plates has an electro-magnet attachment which will not only hold the colder plates but act as a detector for a plate which has not retained the proper temperature between the time it leaves the furnace and the forming machine; the magnet will draw the colder plate back and not allow it to fall into the quenching vat, until it is reheated to the proper temperature.

This improved spring-forming machine is located on top of the quenching vat, and when a plate is formed a section of the table moves down into the oil vat and the plate is tipped off into the oil. The section of the table then raises to its former position. By this new method the time consumed by the plate from the heating furnace to the oil vat

would be approximately fifteen seconds. There is very little loss of heat between the furnace and the quenching vat.

The next improvement applies to the quenching vat, a place where we have not been getting very good results. According to the old method a plate is left in the oil from one to perhaps five minutes, depending entirely upon the judgment of the operator. By the proper system the steel should be left to cool until it is down to normal temperature, 240 deg. F. or less, and not under 90 deg. F.

To accomplish this will take a definite amount of time, depending upon the temperature of the oil. This temperature I would regulate as follows: As the plates are lowered from the forming machine to the quenching vat, a removing conveyor line moves a certain distance each time a plate is formed. By the time a plate is dropped into the oil vat, the movement of this machine controls the removal of the plates from the oil vat, and this takes more time for heavy than for light plates, depending upon the size of the spring to be manufactured. Also with the improved spring forming machine, a section of the table lowers into the oil vat and causes less warping of the plates than with the old method of using tongs.

Quenching Medium: It is necessary that a quenching medium be used of such character as will develop at all times the highest initial hardness, thus permitting the largest drawback to be used. Such an oil should have a uniform quenching speed from atmospheric temperature or room temperature to 250 deg. F. or more. Mineral oils are objectionable due to rapid distillation which alters their quenching speeds. Mineral oils are also objectionable due to the fact that they alter their quenching speeds at varying temperatures of the bath.

The next step in the process is the tempering or drawing of the temper. This is a most important step, because the drawback governs the ductility of the spring. By the old method it was necessary to depend upon the judgment of the operator as to time and temperature. Moreover it was impossible to secure uniform heat at low temperatures.

In order to secure uniform results in the drawbacks, it is now recognized as necessary to have proper furnaces or a liquid bath for this operation. If using furnaces, they should be gaged with pyrometers and also equipped with a traveling hearth at one end so as to speed up the operation and increase production. Plates are placed on this hearth and allowed to pass through the furnace at a certain rate of speed, the time or speed of this table depending upon the size of the steel to be tempered. However, the liquid bath is recognized as giving the most uniform results for this operation. These baths are composed of chemical salts which liquify at temperatures around 200 deg. F. and can be used satisfactorily up to 1,000 deg. F. or more. They can be easily maintained at a uniform, predetermined temperature, and will transfer heat uniformly to the steel very rapidly, thus increasing production.

The next operation is banding the spring. This should be done with hydraulic pressure and the band should be left in the press to cool until it is down to 400 or 500 deg. F.

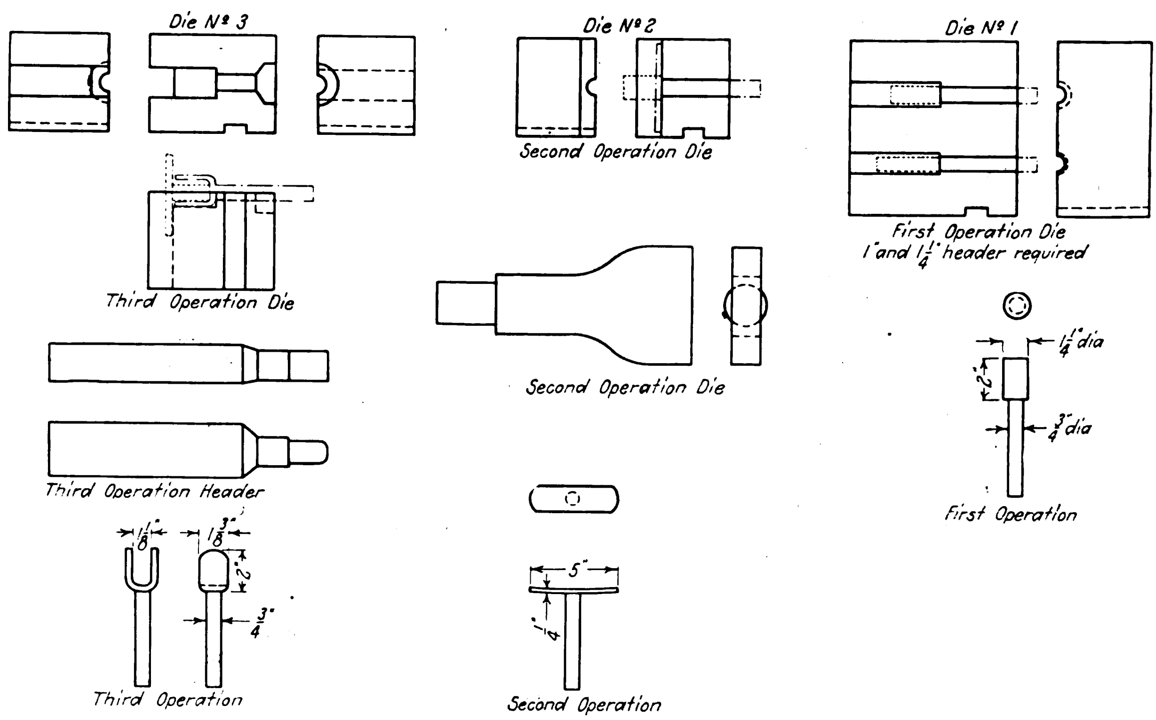
We have found from experience that by refitting 75 per cent and normalizing the steel of repaired springs, we increase the life 100 per cent. To refit all springs by the above improved method would further increase the life of the springs 200 per cent and decrease the cost over the old hand method 75 per cent. The improved forming machine used in conjunction with the cooling and drawing system will produce the serviceable springs required in heavy types of modern locomotives.

Car Stanchion Bracket

By W. J. Mayer

Blacksmith Foreman, Michigan Central, Detroit, Mich.

The attached drawing illustrates the dies used for making mail car stanchion brackets. This bracket is made of three-quarter-inch soft steel eight inches long. The first operation in die No. 1 is a two step upsetting operation of the three-quarter-inch rod to one inch in diameter and one and one-quarter inches diameter on one end. The upset end is then flattened in die No. 2 to ¼ in. by ⅜ in. by 5 in. as shown in the illustration. After this the forging is taken to the punch and the ends cut round on a half-round die. The forging is then formed in die No. 3 to the finished bracket. This is one of the jobs showing the possibilities of the forging machine in railroad blacksmith shop work.



Dies Used for Making Mail Car Stanchion Brackets from ¾ In. Soft Steel Eight Inches Long

Twelfth Annual Convention of Tool Foremen

Meeting at Chicago Notable for Presentation of Many New Jigs and Labor Saving Tools

THE twelfth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, September 3, 4 and 5. The convention was called to order by President G. W. Smith (Chesapeake & Ohio). The principal address by J. A. Anderson, superintendent of shops, Chicago, Milwaukee & St. Paul, was a forceful appeal to the tool foremen on American railroads to make an intensive study of their work with the idea of producing more efficient toolroom methods, jigs and fixtures, thereby enabling locomotive and car repair work to be speeded up and its cost reduced. An abstract of Mr. Anderson's paper follows:

Address by J. A. Anderson

Railroad men are easy to meet, love to talk about their work, and are ever ready to hear the other fellow's side of the story; so much so that in many cases would-be dispensers of knowledge have attempted to point to the railway shops as shining examples of inefficiency. I want to say right here without any apologies that the returns of the railway repair shops of this country will compare favorably with the returns from any other repair industry. The railway shops have done more toward adapting repair work to a production basis than any repair industry I know. This is where the tool foremen have played no small part. The tool foremen of the American railways should feel proud of their achievements. Go to any railroad shop, be it large or small, and you will find ways and methods of doing work to meet the demands, notwithstanding ofttimes lack of equipment.

No sooner does the necessity appear for a new tool, jig, templet, or labor-saving device, be it ever so visionary, than the tool foreman suddenly breaks into the general foreman's office with one more labor-saving device, doing his part towards reducing the cost of transportation. Here is where the Tool Foremen's Association should function. Your year book should be a standard text on jigs and fixtures for railway shop use. I have looked over your proceedings the past few years. While there has been some advancement in this direction, the American Railway Tool Foremen's Association can make itself an authority on railway shop tools.

Your duties as tool foremen are many. Check up and show your respective shop managements how to save money. The items requiring your attention are too numerous to mention such as line shafts out of line; running at slow speeds; pulleys not in use, consuming 1/8 to 3/8 hp. churning air; design and manufacture of forging dies, eliminating hand smithing and reducing the machining time, the field is unlimited; punch press stamping and forming dies (we have not taken the full advantage of the punch press possibilities in railway shops).

Proper selection of belting: This item alone runs into thousands of dollars a year, the service will be improved to say nothing of the money saved.

Grinding material and wheels: The service obtained is dependent on the proper selection as to size, grain, speed and feeds giving due consideration to the design of safety devices.

Forging and grinding of tools: Tools improperly prepared increase power consumption at the point of the tool as well as slowing up production.

G. W. Smith (A. T. & S. F.)
President

G. W. Helm (C. M. & St. P.)
First Vice-President

George Tothill (B. R. & P.)
Second Vice-President

E. A. Hildebrandt (C. C. C. & St. L.)
Third Vice-President

Designing of jigs and fixtures to do work in accordance with engineering specifications. Study the returns from the various sizes, brands and makers of shop tools, advising your management the tools giving the best returns.

I have in mind a foreman specifying a combination ring gear chuck for work for which it was not suited. This could not happen if all orders for tools originated or were approved by the tool foreman.

While I will not take the time to review the possibilities further, a large part of the tool room foreman's time is taken up in repair work; autogenous welding and cutting equipment, jacks, air hammers and drills. It does not pay to go too far into repair work perpetuating old tools. Analyze each item; set up the repair cost in such a manner as to know what you are getting for money spent.

A new chipping hammer costs $45. Does it pay to repair an old hammer requiring a new barrel at $23? A new barrel means a new piston, $3 extra. By the time you add labor charges, plus overhead, taking into consideration the

$5 credit the manufacturer will allow on the old tool, or possibly keep the good parts for repairs, it is decidedly questionable if it pays to reclaim the old tool.

Just one more thought. Are you using your tool room force to manufacture standard tools that can be purchased cheaper and better in the open market? You may think you are doing the work cheaper, but if all expenses and overhead are taken into consideration, the railroads will not attempt to manufacture standard tools that can be purchased.

We must not overlook the human element. While the tool foreman may not have supervision over a great number of men his influence is felt throughout the shop.

The tool foreman should encourage initiative, offer a word of encouragement where merited, do things to create interest, help make men. After all it is men, real honest-to-goodness men, that are needed in the shops and tool rooms throughout the entire service to make the railways of this country function.

Are you building on a solid foundation? Are you helping to make tool makers? Are you training men to think clearly? Training them to shoulder the responsibilities of the future? If not, you are not doing your full duty as a railway supervisor.

Election of Officers

The following officers were elected for the ensuing year: President, Charles E. Helm, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; first vice-president, E. A. Hildebrandt, Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis, Ind.; H. E. Barnes, Southern Pacific, Houston, Tex.; third vice-president, H. P. Jones, Oregon Short Line, Pocatello, Idaho. The association elected as secretary G. G. Macina, Chicago, Milwaukee & St. Paul, Chicago.

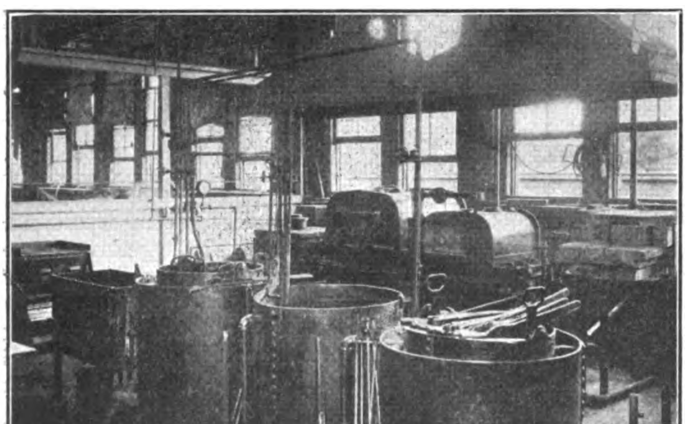
Report on Heat Treatment of Steel

By Henry Otto

Atchison, Topeka and Santa Fe, Topeka, Kans.

Papers on the heat treatment of steel have become a permanent feature at our conventions and in our opinion it should be so, for we all know that the above subject is the most vital point in the making of tools.

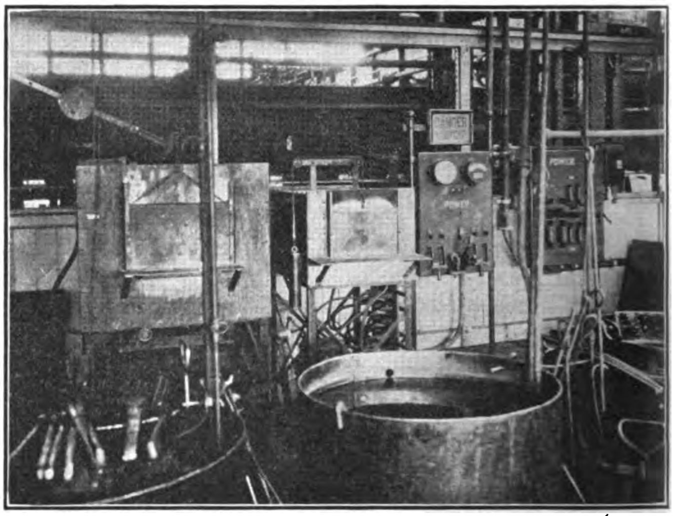
As we progress, new discoveries are made from time to time in steel manufacturing, which necessitate changes in the heat treatment of such steel. The old way of matching colors has been replaced by pyrometers which are more correct in determining the right heat, also eliminating the loss we had, due to over or under heating.



Gas Furnaces and Quenching Baths

We must at all times study the proper method of heat treating steel, and that is the reason that this subject should be a permanent feature of our conventions. In our 1920 year book we had the most complete report on heat treatment ever submitted to this association by C. A. Shaffer, general inspector of tools of the Illinois Central. This report was both technical and practical and I would suggest to have it reprinted in pamphlet form and furnished to all members of our organization if it be possible to do so, for the benefit of the many new members.

The present paper will deal with the handling of the different tools we are making and their heat treatment in the tool tempering room of the Atchison, Topeka and Santa Fe Shops at Topeka, Kansas. The equipment installed in the tool tempering room at the Topeka shops is perhaps as complete and up-to-date as that of any railroad shop tempering room in this country. The list of equipment is as follows:



Electric Furnaces—Switch and Pyrometer Panels at the Right

1 Type FC Hoskins electric furnace, temperature 2,500 deg. F.
1 Type FB Hoskins electric furnace, temperature 2,000 deg. F.
1 General Electric heated oil drawing bath.
2 Gas furnaces, made by the American Gas Furnace Company.
1 Open gas furnace, home made.
1 Lead pot furnace, home made.
1 Water quenching bath, home made.
2 Oil quenching baths, home made.

Hardening and Tempering H. S. Steel Tools

The following method relates to flange tools or wheel contour finishing tools, flue hole cutters, flue hole reamers, boilermaker countersinks, 60 deg. axle center countersinks, helical cutters, various milling cutters, etc.

We preheat these tools in the Type FB electric furnace up to 1700 deg. Fahrenheit, leave them in the furnace for about twenty minutes, then transfer them to the Type FC furnace, which has been heated to 2250 deg. Fahrenheit. We leave the tools according to size from 1½ to 3 minutes in this high heat, then drop them in the oil quenching bath, after which they are cooled in the oil, taken out and temper drawn to suit.

In the above way we do all our high speed tool hardening and tempering, preheating tools to the same temperature (1700 deg. F.) but the high temperature is applied according to the size of the tools. It is the high temperature when the tool is left too long in the furnace, that causes trouble. If left too long, the tools will crack in quenching them. Here is where the tool hardener must watch his work closely.

All small high speed tools such as inserted blades for milling cutters, journal box cutter blades, bolt cutting and threading dies, etc., are hardened in a home-made gas

furnace. We do not put them in the electric furnace because of their smallness, they being more easily handled in the gas furnace.

Heat Treatment of Alloy Steel

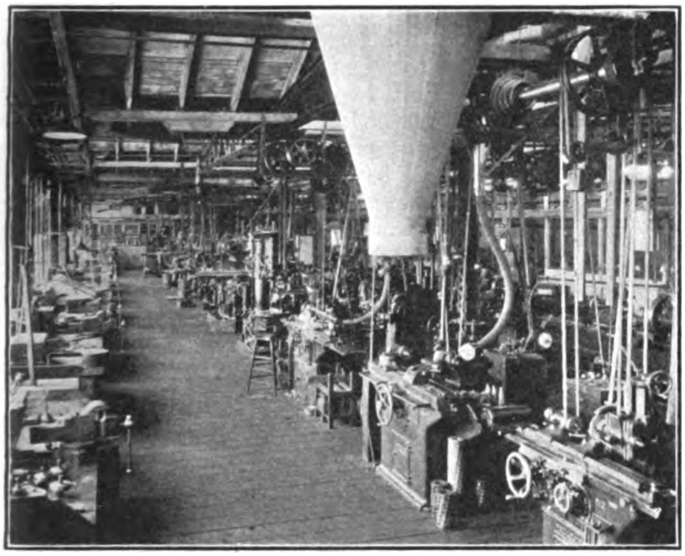
The following is our practice in heat treating scale pivots made of special alloy steel:

From ½ in. thick to 1¼ in. wide, quenching heat 1,450 to 1,525 deg. F.
From 1¼ in. thick to 1½ in. wide, quenching heat 1,550 to 1,575 deg. F.
From 1½ in. thick to 2 in. wide, quenching heat 1,575 to 1,600 deg. F.

All of the sizes of pivots shown should remain in the electric furnace twenty minutes and then quenched in a Signal oil bath, the Signal oil should be heated to 200 deg. Fahrenheit before quenching them, when cold remove them and draw in electric oil drawing bath to 430 deg. Fahrenheit and leave them in the drawing bath with above mentioned heat for fifteen minutes.

Heat Treatment of Carbon Steel Tools

Heat carbon steel tools in the electric furnace to 1400 deg. F. Then quench in water, but be careful not to use the quenching water too cold. It is better to heat the water to 100 or 110 deg. F. before quenching the tools. If water is too cold it will cool the surface of the tool too quickly and will form cracks on the tool. After the tools are cooled in the quenching bath, clean them and draw the temper in the electric heated oil bath, to the degree to suit the kind of work they are to do. There is a little difference in the heating of carbon steel. High carbon tool steel should not be heated over 1400 deg. F.; lower carbon steel should be heated up to 1475 deg. F., before quenching.



Toolroom at the Atchison, Topeka & Santa Fe Shops, Topeka, Kan.

Having electric equipment it is a simple matter to harden and temper carbon tool steel correctly. There is no guess work because all heats are measured by pyrometers and thermometers, which with careful checking do not fail. I have not lost any tools during the operation of heat treating since we have installed electric furnaces and electric heated drawing baths. I have been using them since March, 1917. I want to impress too, every member of our organization who has made any amount of tools for his company with the importance of electrical equipment for this class of work and suggest they take it up with their superior officers to get this up-to-date equipment.

It is certainly annoying to the tool room foreman when he has made a new tool at great cost to send it to the blacksmith shop and then have it spoiled in the heat treatment. There is a great saving for any company to have up-to-date equipment for heat treating steels under the supervision of the tool room foreman.

Don'ts in the Heat Treatment of Steels

Don't preheat your high speed tools too fast, but let the heat penetrate through. It will give you the best results in high heat.

Don't let your high speed steel tools soak too long in the high heat before quenching, or you will lose them.

Don't overheat your carbon steel tools; if so, do not quench them, but lay them in a dark place until cooled off and then bring them to the right heat and quench them. In doing this you will save the tool.

Don't have any visitors in your tempering room during the heat treating of tools or you may spoil your work.

Don't quench your tools in water, unless you know it has the right temperature. Put your thermometer in the water and see that the water is not too cold; cold water will crack the tools.

Don't take the tools out of the quenching bath until they are cooled off; removing them when hot will cause them to crack in the open air.

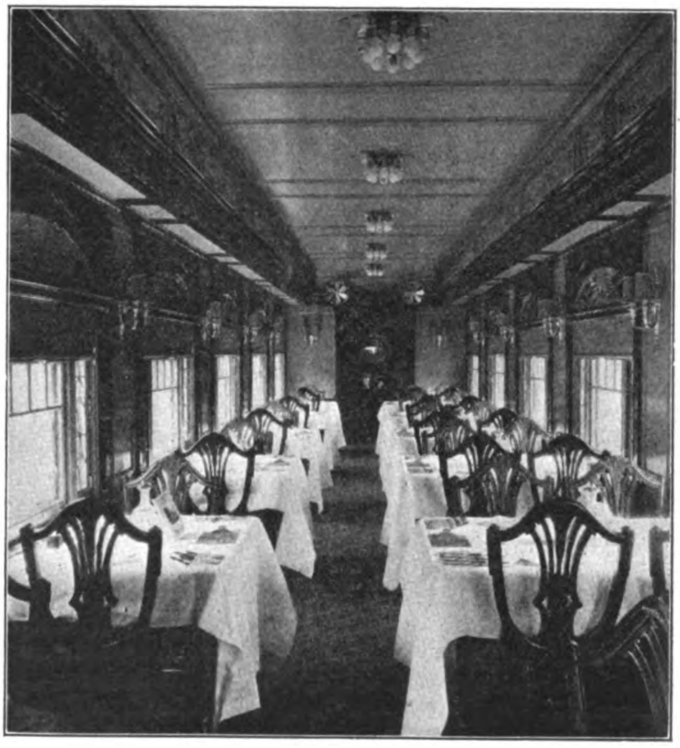
Don't take the tools out of the drawing bath too quickly but give them time to get the right temper before removing.

Don't think of other things when you watch your heats, but have your mind on your work. This is more important to you; right thinking means money to your employer.

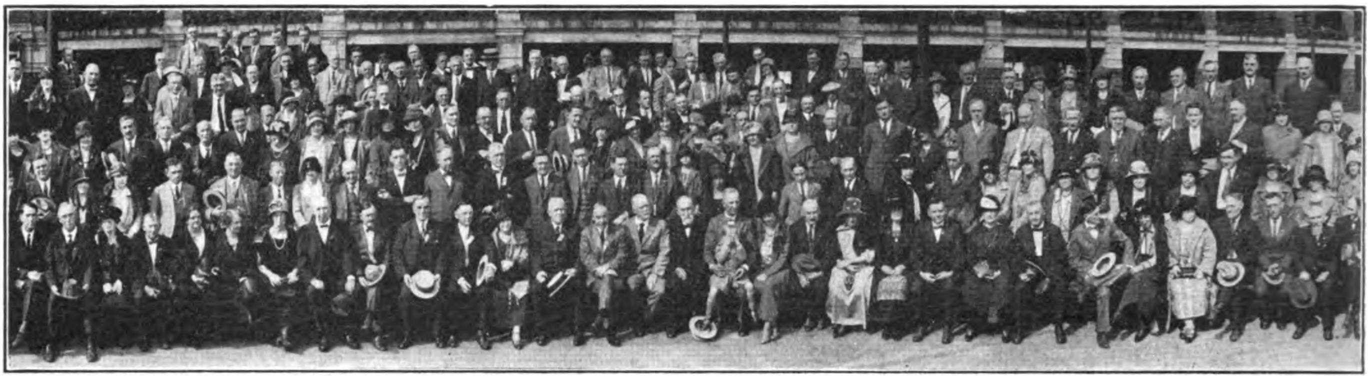
Don't do any work or use any methods by which you endanger yourself or your fellow worker. Safety first should be your permanent way of doing work.

Don't think you know it all, but listen to good advice given by your steel agent in regard to handling his steel. He represents the maker of the steel and knows more about the heat treatment of the steel than you do. If in practice you find something better than he told you, let him know the good news and he will pass it on to others who are using his steel.

[Other papers read at the convention will be abstracted in subsequent issues of the *Railway Mechanical Engineer*.—EDITOR.]



Every Detail Harmonizes Perfectly and Adds to the Colonial Atmosphere of the New B. & O. Diners



A Group of Members and Guests at the Convention of the Equipment Painting Section, A. R. A.

Master Painters Hold Convention at Chicago

"The Protection of Steel in Freight and Passenger Equipment from Corrosion Is of Vital Importance"

THE Equipment Painting Section of the Mechanical Division of the American Railway Association held its third annual meeting at the Hotel Sherman, Chicago, on September 2, 3 and 4. R. H. Aishton, president of the American Railway Association, was to have delivered the opening address but could not be present. W. E. Dunham, superintendent of the car department of the Chicago & North Western, spoke in part as follows:

F. W. Bowers
Chairman

A. E. Green
First Vice-Chairman

James Gratton
Second Vice-Chairman

Address by W. E. Dunham

"This is the age of the specialist, and the painter of railway equipment must be a specialist in every sense of the word if he expects to meet properly the situation confronting him. Being a specialist does not anticipate narrowness of vision on his part. Narrowness makes for crankiness and that is exactly what we do not need or want. The protection of steel in freight and passenger equipment from corrosion is of vital importance to railroads now and is becoming more important every day. The master painters should go on record in a straightforward, two-fisted manner as to what must be done with this steel from the time it is made ready, piece by piece, for erecting, until the car is completed, to stop the fearful waste that rust is causing. With such experience as you and others have had since the first steel cars were made, and with your knowledge of present-day shop practices, this can and will be done." Mr. Dunham went on record as favoring a committee report on shop and maintenance practice to be used by members of the section as recommended practice. He also spoke at some length on the necessity of encouraging railroad employees to be loyal, especially at the present time when so much social and financial unrest is prevalent, and when a constant stream of cure all plans is being presented by men whose chief claim to recognition is "loudness of voice or the astuteness of their press agents."

New Officers Elected

The following new officers were elected: chairman, F. W. Bowers, foreman painter, Erie, Kent, Ohio; first vice-chairman, A. E. Green, foreman painter, Chicago & North Western, Chicago; and second vice-chairman, James Gratton, general foreman painter, Buffalo, Rochester & Pittsburgh, Dubois, Pa. In addition to the three officers mentioned the following have been elected members of the Committee of Direction: H. C. Allehoff, foreman painter, Oregon-Wash-

ington Railroad & Navigation Company, Portland, Ore.; W. Mollendorf, foreman painter, Illinois Central, Chicago; J. McCarthy, foreman painter, Canadian National, Montreal, Que.; H. Hengeveld, master painter, Atlantic Coast Line, Waycross, Ga.; F. E. Long, foreman painter, Chicago, Burlington & Quincy, Aurora, Ill.; J. W. Gibbons, general foreman locomotive painter, Atchison, Topeka & Santa Fe, Topeka, Kans.; J. F. Gearhart, foreman painter, Pennsylvania, Altoona, Pa.; and B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J.

Economy in Painting Railway Equipment

By J. W. Gibbons

General Foreman Locomotive Painter, Atchison, Topeka & Santa Fe

For years past, the thought has been expressed that all trades or crafts, except the painters, have advanced in methods of doing work by machinery so that they have been enabled to meet the demands of civilized society at a price

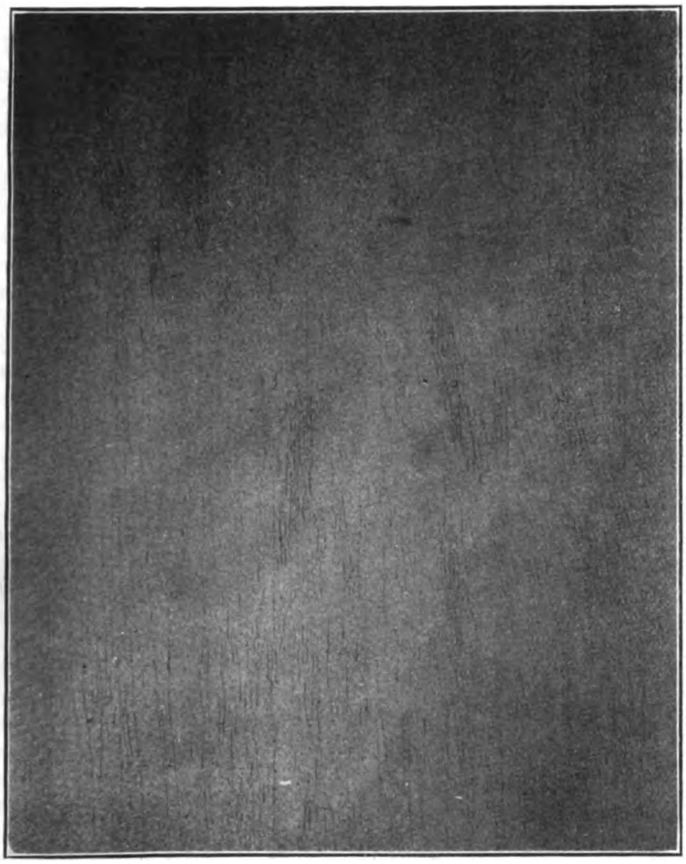


Fig. 1—Surface of a Steel Car in Service So Long that the Paint Had Checked and Cracked—Photographed After Sandblasting, Showing Where Corrosion Had Eaten into the Surface of the Metal

within the reach of even the humblest citizen. It has been the boast of the unthinking painter that his craft is still doing work with practically the same tools that were in use one hundred years ago. To the thoughtful workman, this brought the realization that an art or craft that did not progress would surely die. He has been compelled to see all ornamentation removed, piece by piece, from both the exterior and interior of railway equipment, as well as to see the surface applied reduced to the lowest possible number of coats that will retain a surface that can be easily cleaned and present a fair general appearance. Even this is threatened and some railroads are giving their passenger cars and locomotives but little better paint treatment than the average railroad gives its freight cars. This has brought about a condition that makes it practically impossible to get good, intelligent apprentices for the trade. Personally, I believe that we have gone as far as, if not farther, along this line than good service and proper sanitation permit.

Paint Spraying Devices the Remedy

It is inconceivable that the public that demands and obtains cleanliness, neatness and ornamentation in and around their homes, are going to patronize a railroad that permits the general appearance and sanitary condition of its equipment to further depreciate. The remedy at hand to obtain the desired economy without further depreciation is the installa-

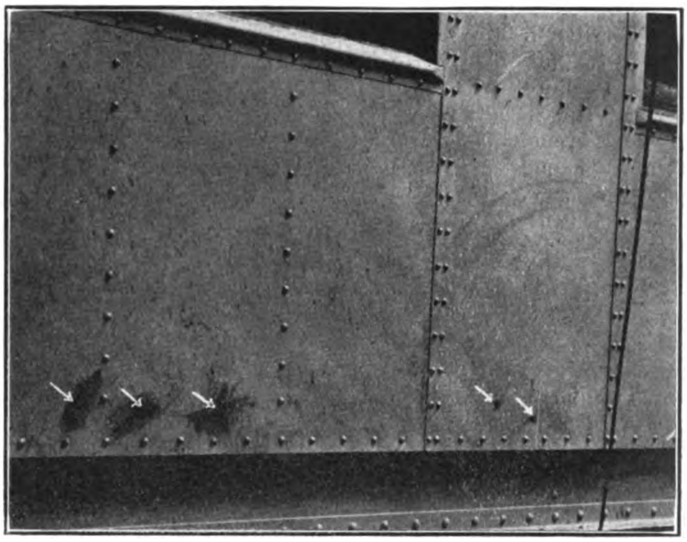


Fig. 2—Holes Eaten Through Steel Dining Car Due to Lack of Proper Paint Protection on the Inside of the Sheets

tion of spraying devices that will apply paint at the lowest possible cost and still maintain the appearance and protection necessary.

Machinery has really promoted efficiency and increased the demand for men of the crafts where they have adapted themselves to new conditions. It will do the same for the painters' trade, if the men apply themselves and assist in improving the machines and thus keep the cost of ornamentation and paint protection within the reach of all.

It certainly is false economy to purchase paint, varnish and enamels on price only, regardless of durability, appearance, working qualities or covering power. That this has been done by the purchasing departments on some roads has been charged in past conventions of this association, without any apparent effect. This discourages the loyal, intelligent foreman and the company does not get the service it should, either from the men employed, or material purchased. From time to time, committees of this association have reported upon the advisability of purchasing paints by specifications.

Regarding Railroad Specifications

Recently my attention was called to a case where a certain railroad was buying a paint upon specification of its own and the manufacturer called their attention to the fact that he could give them a better grade of paint for $5.00 less per cwt. than they were paying for the paint bought on specifications, and he submitted an analysis of their product in proof thereof. This was checked up and their claim was substantiated and they were given the business. This is true economy; but how many thousands of dollars are lost by the railroads continuing to follow a discredited practice.

The question is asked, "But how are we to protect our com-

panies from deception and substitution of inferior material?" We have frequently pointed out that after practical and film tests have demonstrated the quality of a material, analysis of same should be made and any time a question is raised as to a quality, they should be checked up to determine whether materials have been maintained like the original shipment.

The photographs, Figs. 1 and 2, demonstrate the great deterioration that occurs when steel is not properly protected.

Fig. 1 is picture of car that had been in service for several years without paint treatment. The old paint and varnish surface was checked and cracked and when old paint was sandblasted off, it was found that the rust had eaten into the surface of the steel where it had been exposed to weather, as clearly as if it had been etched with acid. Is this economy?

Fig. 2 is picture of a dining car where moisture penetrated. A few cents were saved on original cost that has run into dollars and several days' time to repair damages, and yet we find in a very large per cent of railroad shops, the foreman painter has nothing to say as to the material he shall use or the methods used in applying them. Under these conditions, is it any wonder that in traveling over the country, we see railroad equipment that has cost millions of dollars to purchase and maintain, deteriorating rapidly by corrosion or decay, due to lack of paint protection.

Therefore, in defining what "Economy in Railroad Painting" means, I would say the exercise of the same good business sense that is exercised in the management of other railroad departments. *Employ competent supervisors* and give them sufficient authority to bring about the desired results.

Shop Construction and Equipment

At the meeting of the committee it was the opinion of those present, that the subject assigned them, "How must the paint shop be equipped to make it practical for the use of paint sprays"; presented a phase of paint spraying that very few of our roads have taken up, especially the spraying of passenger car bodies.

The committee fully realizes the importance of this subject and the fact that the members all will, sooner or later, be called upon by their various roads to ascertain the advisability of the use of the paint spray for the application of the various coats of paint and varnish to the exterior and interior of passenger equipment.

It is well known that the objectionable features of the spraying of paint inside of shop buildings are the fumes and mist that arise from the operation which greatly endanger the health of all those whose duties require their presence in the immediate locality, also the damage caused by the settling of this mist upon other equipment. It would seem then, this would be the greatest problem to overcome along the lines of shop equipment to successfully handle this work.

You all, no doubt, are familiar with the methods in use to overcome this objectionable feature by the various industries who are successfully using the spray for finishing small articles. These devices, however, would not be practical for passenger car spraying, except for removable parts.

A great deal of thought, time and money have been expended by various concerns in the improvement of paint spraying devices, and great improvements have been made over the crude devices a great many of us have experimented with in the past, and it has been brought to the attention of this committee that at least one firm claims to have perfected a device that will eliminate the mist and vapor that has made paint spraying so objectionable in the past. Your committee, would suggest this subject be carried over for further investigation.

The report was signed by J. F. Gearhart (Chairman), foreman painter, Pennsylvania; A. J. Bishop, foreman painter, Northern Pacific; A. H. F. Phillips, foreman painter, New York, Ontario and Western; E. B. Stair, master car painter, Atlanta and West Point; B. D. Mason, master painter, Colorado and Southern.

Removing Paint, Varnish and Corrosion

Your special committee on removing paint, varnish and corrosion respectfully submit the following report on the several subjects assigned it:

1. What is the best and most practical method of removing paint and varnish from the exterior of passenger cars where sand blast is not available?

Ans. Reiterating former reports made to conventions of this association, we desire to emphasize the fact that sandblasting is the best and most economical method of removing paint, varnish or corrosion from exterior or interior of steel equipment and we desire to state that in our opinion sandblast facilities are available to all who desire to use them. However, pending the installation of sandblasting facilities the following methods are available.

1st. Burning with special arranged torch and proper gas. This method cannot be used economically on a surface constructed of heavy steel plate on account of the amount of gas required to heat to a blistering temperature.

2nd. Varnish removers are the best and most economical. The great objection to their use, outside of the time required to remove the paint, is their inflammability, which greatly enhances the danger of fire hazard and increases cost of insurance.

3rd. The old lime and lye method is available although some of the enamels used in finishing railroad equipment are not as easily removed with it as the flat color and varnish system. Another objection to its use is the fact that water must be used freely on the surface to remove all trace of the lye. In all cases where the lime and lye method is used, after the surface has been thoroughly washed with water and dried, it should be washed with a mixture of 1/3 vinegar, 1/3 raw linseed oil, 1/3 turpentine and wiped off with dry waste.

2. Is it practical to sand blast the exterior of steel coal cars before painting?

Ans. It is practical and the most economical method known.

3. What is the next best method of cleaning rust and scale off of steel freight cars when sandblasting is not available?

Ans. The pneumatic hammer and chisel and revolving steel brush are the most practical and economical for the above purpose where sandblast is not available.

4. Are the modern pneumatic brushes and tools now being introduced on the market desirable and economical when compared with other devices for cleaning rust and scale off of steel equipment when compressed air is available for the use?

Ans. The answer to Question No. 3 will cover Question No. 4.

The report was signed by J. W. Gibbons (Chairman), general foreman, locomotive paint, Atchison, Topeka & Santa Fe; G. J. Lehman, foreman painter, Chicago & Eastern Illinois; James Gratton, general foreman painter, Buffalo, Rochester & Pittsburgh.

Discussion

The discussion of this report was not extensive but indicated beyond doubt that the great majority of members were strongly in favor of sand blasting as the most rapid, economical and satisfactory method of removing paint, varnish and corrosion from steel cars before painting. Discussion brought out the opinion that where foremen painters are sufficiently convinced of the merits of sand blasting, they are in a position to submit adequate evidence to their superiors to insure the necessary sand blasting house and equipment being supplied.

Report on Standards—Car and Locomotive

Your committee was assigned several subjects for investigation and report during the year.

What success, if any, has been obtained to prevent paint peeling from galvanized iron car roofs? It is the unanimous opinion of your committee that as applied to galvanized iron in car roofs it is primarily for appearance and that the galvanizing without paint should protect the iron approximately the same length of time as the paint. Appearance, however, is an important factor in passenger equipment cars. Your committee has carefully considered the following methods of painting galvanized iron roofs on passenger equipment cars and will, during the coming year, conduct tests of each of these methods and report more definitely to you at the next meeting of the Section:

(1) Princess mineral thinned with oil and colored to suit—one coat.

(2) Slush varnish and mineral mixed for primer and one coat of color—two coats.

(3) Slush varnish for primer and one coat of standard roof paint—two coats.

(4) Sand blasted lightly, one coat of red lead (U. S. Government formula), two coats of standard roof paint—three coats.

It is the opinion of your committee that the painting of new galvanized iron roofs of freight cars is only a matter of appearance, therefore, your committee recommends that such roofs be run for at least one year before painting. When painted it is the belief that any kind of paint used on freight car bodies should be satisfactory.

What is the most practical and economical method of bringing up interior of passenger coaches for graining or coloring? The committee believes that the members should give most earnest consideration to the economies made possible by reducing the number of coats applied to both exterior and interior in painting of steel passenger cars. The committee will keep in close touch with this subject during the year and report further at the next meeting of the Section. It is the consensus of opinion of the committee that railroads are applying too many coats of paint and materials to steel passenger cars to the detriment of the material being protected. The members are also requested to give earnest consideration to the savings possible by eliminating all or a large portion of the rubbing now practiced on certain roads in connection with a reduction in the number of coats of paint or other material applied.

Advisability of using flat tone finishes for interior of passenger cars instead of gloss finish. It is the opinion of your committee that it is impractical to use what is known as flat tone finish for the interior of passenger cars as it will not stand cleaning and will cause trouble in repainting the car, as flat tone finishes usually have a certain amount of wax incorporated therein.

Should canvas roofs of passenger cars be painted at each shopping? It is the opinion of your committee that it is a good practice to give a light or thin coat of paint to canvas roofs of passenger cars when shopped. While this is perhaps unnecessary it gives the car a better and more finished appearance. It is not considered proper to apply too much thick paint to these roofs as it has a tendency to break and this does the opposite of what is intended.

What parts of a locomotive should be varnished? It is the opinion of your committee that locomotive cabs, sand boxes and tenders should be varnished if it is desired to keep them clean under all conditions.

Does it pay to protect steel underframes, brake beams, air brake rigging and trucks of freight cars with paint? It is the opinion of your committee that steel underframe should be painted each time car is painted but so far as trucks and brake rigging are concerned it is principally a question of appearance.

In addition to the foregoing your committee had referred to it the following question:

What is the most economic and practical material for passenger car headlinings?

The report was signed by A. E. Green (chairman), foreman painter, Chicago and North Western; G. H. Lehnen, foreman painter, Chicago and Eastern Illinois; F. E. Long, foreman painter, Chicago, Burlington and Quincy; J. N. Voerge, general master painter, Canadian Pacific; James Gratton, general foreman painter, Buffalo, Rochester and Pittsburgh; D. C. Sherwood, foreman painter, Car Department, New York Central; John Cook, foreman paint department, Pullman Company.

Discussion

One of the most important points brought out in the entire convention was discussed following the reading of this paper and related to the possibilities of economy by reducing the number of coats applied when railroad equipment, particularly passenger cars, is painted. Some railroads apply as many as 10 or more coats from the primer to the last coat of varnish and what this means in labor cost, material cost and time required for putting the equipment through the shops, can be readily appreciated. At least one road applies only four coats and secures results which are apparently entirely satisfactory, both in protection of the steel equipment and in appearance. The entire matter was summarized by one member briefly as follows: The object of painting equipment is to protect it and give it the desired finish. Four coats will give the desired protection and in fact in some cases may offer greater protection than a larger number of coats owing to the greater elasticity and durability. The kind of finish required, however, is dependent on railroad standards and what each road believes that the public requires. As a rule, the public is a far less keen and critical observer than the foreman painter and in all probability many railroads would be able to reduce the number of coats applied in painting passenger equipment without making any difference whatever which would be discernible to the average observer. If a railroad has some "finicky" higher officer who demands a degree of finish on passenger equipment superior to a good average finish, it follows that the extra coats must be applied and the railroad stand the cost.

Report of Committee on Tests

Your committee has had the following subjects referred to it for investigation and report:

(1) What pigments are suitable substitutes for white lead?

(2) Specifications for white lead?

(3) What pigments are the most suitable for the protection of metal surfaces on railway equipment?

In trying to arrive at a satisfactory solution of the first problem it is well to enumerate the various whites in use. White lead in general use is a carbonate of lead prepared by submitting lead to the action of acetates. It is poisonous, especially when mixed with turpentine or substitutes. The chief adulterations are barytes and whiting.

Carbonate of barytes is less poisonous than lead. It is not as valuable and has very little body. It is whiter and when used in proper proportion makes a very good white and does not injure the lead for ordinary purposes.

Zinc white is an oxide of zinc. It is a durable and beautiful white and is harmless. Some of the finest work is finished with zinc. It has less body than lead, but is vastly whiter and does not turn yellow when excluded from the light and air.

China white is lead that has been washed, thereby freeing it from impurities.

There are various other whites on the market, such as

pearl white, which is generally used for the finer and more delicate branches of painting.

There is also a silver white which is similar to china white as is largely used for tube colors.

There are various whites which are all serving good purposes along special lines. It is the opinion of your committee, however, that a suitable substitute for white lead, one that will answer all the requirements of a pure white lead, has not yet been developed.

For substitution of other materials for white lead intended to give protection under the usual exposure conditions, particularly metal surfaces, where color is not important, the following table is submitted.

Average Ratings of Pigments

The rating of 10 indicates maximum value as a Rust-Inhibitor

No.	Pigment	1910	1914
4.	Sublimed white lead	9.5	3.5
5.	Sublimed blue lead	9.6	6.0
9.	Orange mineral	9.0	3.0
10.	Red lead	8.8	4.0
12.	Bright red oxide	9.3	2.5
14.	Venetian red	7.2	1.5
15.	Metallic brown	6.3	3.0
16.	Natural graphite	9.1	4.0
17.	Artificial graphite	7.1	0.0
19.	Lamp black	7.1	0.0
20.	Willow charcoal	8.8	4.5
21.	Carbon black	8.3	5.0
24.	Yellow ochre	5.8	1.5
34.	*American vermilion	9.1	7.5
36.	Medium chrome yellow	7.0	3.5
39.	Zinc chromate	9.4	4.0
40.	Zinc and barium chromate	9.7	2.5
41.	Chrome green	9.8	5.0
44.	Prussian blue (water stimulative)	9.2	3.5
49.	Zinc and lead chromate	9.5	4.0
51.	Magnetic black oxide	9.5	4.0

*Note—No. 34, American vermilion (basic lead chromate) is given the highest rating as a rust inhibitor.

Exhibits will be submitted at the meeting demonstrating the effect of the different pigments used in the manufacture of leads and paints showing the action of each in twelve and twenty-four hour periods.

Specifications for White Lead.

It is the recommendation of your committee that white lead furnished by the manufacturers for railway equipment painting be made in accordance with the A. R. A. Mechanical Division Specifications, as shown on Pages 105 and 106 of the Manual of that Division, in order to insure purity and wearing results.

Pigments most suitable to protect metal surfaces.

Paints for metal surfaces have different functions, in many respects, to those for wood. In painting metal there is not the absorption into the pores, except to an extremely limited extent, as compared to wood. For this reason there must be some other way for getting the strong clinging effect that the pores of wood afford as an anchorage. Once the priming coat is well anchored, the subsequent coats, if properly made and well applied, anchor themselves one on the other, finally depending for their adherence on the fastness of the priming coat and the strength and elasticity of the paint film.

It has been established that the fewer number of paint coats on metal, which will give the maximum protection, the longer wearing and better service will the paint coating give. Considerable experience has been had by the members during the past few years in reducing the number of coats applied to steel passenger cars and the economies in this connection should not be overlooked, but the aim of the painter should always be to give the maximum of protection to the steel painted with the least amount of material and labor.

Proper Preparation of Surfaces of First Importance

No matter what pigments or vehicles are used of the first importance is properly preparing the surface for painting. This subject will be discussed at this meeting in another paper.

Your committee is not prepared to make a unanimous report on the best pigment for protecting steel railway equipment and, therefore, will confine its report to those pigments which in its long experience have been used most successfully.

A panel will be shown to demonstrate the results of painting with red oxide as a pigment ground very fine.

Some members of your committee recommend the use of pure red lead or chromate primer.

For painting freight cars some members recommend pure red lead ground in linseed oil as a priming coat, followed by two coats of carbon black.

The general consensus of opinion of your committee is that lead pigments, carbon black and lamp black are the most suitable pigments for the protection of metal surfaces on railway equipment.

Test plates will be exhibited demonstrating the different methods of painting metal surfaces and to show the results obtained with the various pigments being used for this purpose.

The report was signed by John McDowell (chairman), foreman painter, Chicago, Rock Island and Pacific; J. W. Gibbons, general foreman locomotive painting, Atchison, Topeka & Santa Fe; H. Hengeveld, master painter, Atlantic Coast Line; B. E. Miller, master painter, Delaware, Lackawanna & Western; J. McCarthy, foreman painter, Canadian National; Marceau Thierry, foreman paint shop, Norfolk & Western; H. C. Allohoff, foreman painter, Oregon-Washington Railroad & Navigation Company; G. M. Hoefler, master painter, American Locomotive Company.

Care of Paint and Varnish at Terminals

Engines

Cleaning Frequency. Passenger and freight engines are to be cleaned before every trip, and switch engines at least once a day.

Cleaning Method. Before an engine is run into a roundhouse it is to be run over a rack and a washing machine used, where available, to clean the drivers, trucks, frame, spring rigging and the tender trucks. Where washing machine is not available it is recommended these parts be wiped clean with waste and kerosene.

The jackets, cab and tender tank are to be wiped. The wiping is to consist of the use of waste and a half and half mixture of kerosene and paraffine oil, or a renovator. This is to be followed by a dry wiping with waste.

Care of Front End. The front end is to be given care by the application of a suitable front end paint. Whenever there is an accumulation of paint, and the paint shows a tendency to scale, it is to be cleaned off to the bare iron and finished before the engine is put into service.

Painting Frequency. Passenger engines are to be painted once every nine (9) months, freight engines once every twelve (12) months and switch engines every fifteen (15) months.

Painting Facilities. When engines are painted in enginehouses, the rough work is to be done in the enginehouse, and the finishing coats of paint and varnish are to be applied in stalls partitioned off for this purpose. The painting stalls should be properly heated, ventilated, lighted, and free from dust.

Passenger Train Cars—Exterior Cleaning

Daily Cleaning. The exterior body is to be washed off with cold water before leaving its terminal.

Periodical Washing. The body of a car that is in main line service, and in a first class train, is to be washed off with a solution of oxalic acid every 30 days, and when the condition of the body demands it. The solution is to be applied luke-warm (not hot) and thoroughly brushed, after which the body is to be washed off with cold water from a hose, particular care being given to the removal of dirt, grease, and any traces of acid.

The solution of oxalic acid is to be a maximum of 20 pounds to 50 gallons of water. The acid is to be added to

25 gallons (a half barrel) of hot water and stirred until the acid is dissolved. When dissolved, the barrel is to be filled with cold water, and the solution again stirred thoroughly. The solution then being ready to use.

Renovating. The application of renovator is best confined to the better type of cars operating in first class trains. These cars are to be renovated after each periodical washing; the renovating to be done immedately after the car is dry.

To apply the renovator, a handful of waste should be taken and moistened with it, and then applied to the car, care being taken to leave as little as possible on the car. After the renovator has been applied over the varnished surfaces, it is to be carefully wiped dry with clean waste.

Branch Line and Second Class Cars. Branch line and second class train equipment on which no renovator is used, is to be washed with oxalic acid every 60 days. Where renovator is used, the cars are to be washed with oxalic acid and renovated every 90 days.

New and Newly Painted Cars. New and newly painted cars in first class trains should not be washed with oxalic acid until a period of from 15 to 20 days has elapsed.

Trucks. The trucks and underneath rigging on all cars is to be sprayed or wiped with distillate oil. After spraying, the car is to be allowed to make one trip, and upon its return the trucks and underneath rigging is to be washed down with water from a hose.

Avoid Boiler Compounds. Under no circumstances shall boiler compounds, or other solutions be used in an effort to obtain a temporary good appearance for a car, as it will result in the destruction of the varnish.

Passenger Train Cars—Interior Cleaning

Walls and Headlining. The washing of the interior of cars is to be done whenever the conditions demand it. The interior of a coach, sleeper, diner, parlor and other passenger-carrying cars, is to be thoroughly blown with compressed air before being washed.

The headlining, side walls and partition down to the heater pipes, and the seat arms are to be sponged off with a weak solution of soap and water. After the inside of a car is thoroughly washed with this mixture, it is to be rinsed immediately with clean cold water, and wiped dry with a chamois skin.

The soap and water solution is to be mixed as follows: Thoroughly dissolve one (1) pound of vegetable oil soap in a bucket of hot water, adding one (1) pint of this mixture to each bucket of lukewarm water used.

Floors. Floors are to be mopped up. In mopping up floors care is to be taken not to use too much water, nor allow it to remain too long, as floor becomes water soaked and sour, thus giving the car a bad odor. The use of an undue quantity of water also causes damage to steel underframe equipment.

To avoid complaints from passengers about the odor of disinfectant, soap and water are to be used for cleaning floors of passenger cars, except in toilets and floors of baggage and express cars, where one-half (½) pint of disinfectant should be mixed with a twelve (12) quart pail of water.

Vestibules. Inside of vestibules is to be washed with soap and water, and thoroughly dried.

Miscellaneous. Heater pipes, foot rests, seat pedestals are to be cleaned with soap and water when the floors are cleaned.

Milk, Etc., Cars. The cleaning of milk cars, and express cars which are used in the shipments of fish, are to be treated in accordance with the government regulations.

Other Cars. Mail, express and similar cars are to be washed with a soap and water solution whenever their condition demands it.

The report was signed by L. B. Jenson (chairman), shop superintendent car department, Chicago, Milwaukee & St. Paul; W. Mollendorf, foreman painter, Illinois Central; James Gratton, general foreman painter, Buffalo, Rochester and Pittsburgh; F. E. Long, foreman painter, Chicago, Burlington and Quincy; A. J. Allen, foreman painter, Delaware, Lackawanna and Western.

General Foremen Gather for 1924 Convention

Enthusiastic Meeting at Chicago, While Not Largely Attended, Indicates Possibilities of the Association

SOMETHING less than 150 members of the International Railway General Foremen's Association assembled at the Hotel Sherman, Chicago, September 9 to 12, inclusive, and, under the able direction of President G. H. Logan of the Chicago & North Western, held a convention which was an inspiration to all concerned. It is improbable that any general foreman or railroad shop supervisor who attended the convention left it without value received from hearing the addresses, papers and discussions. More than one member commented on the fact that a single new idea received at the convention would often more than pay both himself and his railroad for the trouble and cost involved in sending him. Obviously, the membership of the General Foremen's Association is not nearly as great as it should be and a fixed determination was apparent on the part of the officers and many of the general foremen to corral new members in the coming year and make the International Railway General Foremen's Association the influential body which it ought to be, with a real voice in general matters affecting railroad mechanical departments.

In addition to committee reports, some of which will be abstracted in this and subsequent issues of the *Railway Mechanical Engineer*, the association members listened to an address by H. T. Bentley, general superintendent of motive power and machinery of the Chicago & North Western, President Logan's address and an address entitled, "The Power Plant on Wheels," by L. G. Plant, assistant to the president of the National Boiler Washing Company.

Election of Officers

The following officers were elected for the ensuing year: President, H. E. Warner, shop superintendent, New York Central, Elkhart, Ind.; vice-president, C. A. Barnes, general foreman, Belt Railway of Chicago; second vice-president, F. M. A'Hearn, general foreman, Bessemer & Lake Erie, Greensville, Pa.; third vice-president, W. F. Lauer, general foreman, locomotive department, Illinois Central, Memphis, Tenn. M. R. Benson, general foreman, Michigan Central, St. Thomas, Ont., was elected chairman of the Executive Committee.

Address by H. T. Bentley

Mr. Bentley spoke in part as follows:

So many improvements have taken place in tools, machinery and methods during the past few years that a man who does not read the technical papers and keep up-to-date on the progress made is out of place as a leader of men or to

be in charge of a plant where results obtained are what count.

What is there that you as a general foreman can do to improve the efficiency of your shop? Are you interesting yourself in the education of your apprentices so that they will become good mechanics? A word of advice or encouragement will do a great deal to stimulate the boys' interest.

Are you as full of enthusiasm and ingenuity as you ought to be?

Have you initiative? One man will say it cannot be done, and another will go and do it.

In dealing with your employees treat them as you would like to be treated, but insist on a proper day's work being done. Cultivate a pleasant personality so that the men you come in contact with will work hard for you because they like you and not do so on account of being afraid of you.

Keep records of costs and output of similar machines in such a way that comparisons can be made to justify requests for new tools when you can show in dollars and cents that their purchase will increase the efficiency and decrease unit costs.

We have some shops that are not strictly up-to-date either in tools or equipment, but find that due to the efficiency of the organization, they are getting results that are very gratifying and show up favorably with some of the newer shops. More depends on the organization than the tools and facilities. In other words, I would rather have an old shop with a good organization than a new shop with a poor organization.

The following "leaks" should have prompt attention:

Loafing.
Waste of material.
Machines not working to capacity.
Air, steam and water leaks.
Men waiting for material.
Men having to walk too far for tools and material.
Not starting work promptly.
Washing up before the whistle blows.
Scrap not picked up.
Shops not kept clean.

Thoroughness in doing necessary work to locomotives in shops will probably reduce the shop output somewhat, but materially improve the service and decrease cost of enginehouse maintenance. Slovenly and improper work increases failures on the road and is not an economical proposition notwithstanding records of low costs in the shops. With the close checking that is necessary to keep down expenses it is advisable to watch every operation to see that it is done in the most economical manner. It is possible that some of us overlook things of this character that a stranger would see as soon as he came into our shops.

We are anxious to improve our conditions and positions and the best way to accomplish these results is to do things that stand out and bring us in the limelight. There are a large number of foremen who just get by every day and don't seem to have any ambition to get ahead. You can depend upon it that under conditions that exist, they will have to be demoted as a man who cannot go ahead must of necessity fall behind, and I know your organization does not stand for "tail enders."

G. H. Logan (C. & N. W.)
President

H. E. Warner (N. Y. C.)
First Vice-President

C. A. Barnes (Belt Ry. of Chicago)
Second Vice-President

William Hall (C. & N. W.)
Secretary-Treasurer

President Logan's Address

In times of labor trouble, wherein cessation of normal transportation is threatened, press and public become duly cognizant of the vital importance of railroad transportation, but at other times, the press gives considerable space to the speeches of aspiring (not inspiring) politicians who rave and rant at the assumed crookedness of railroad executives and indicate that if the suffering public will but elect them to office, laws will be enacted to revolutionize railroad operations to the mutual benefit of all concerned. To wit: Increased revenue to the government; decreased rates to shippers, farmers and passengers; increased revenue to the individual states; increased compensation to all railroad employees; better working conditions for all railroad employees; better service throughout the country on established lines by reason of extensions, which of course will be made at once; better maintenance of road bed and equipment; greater safety to the public because of track elevation and the placing of gates at all crossings manned by watchmen working in shifts of eight hours; greater safety for railroad passengers and employees through installation of automatic train stopping devices, etc.

The above conditions and so many other betterments that it is futile to attempt to enumerate them, will be brought about by legislation. The inference drawn from speeches made by these political, voice-operating railroad geniuses is that railroads are actually suffering from lack of laws which govern their operation and yet, the able and discerning writer, Scrutator, in the August 21 issue of the Chicago Tribune, says in part:

"To speak of private management of railroads under present conditions, however, is almost to invite confusion of thought. Government tells the railroads *how much* they can charge for what they have to sell, *when* they can borrow money, *how much* they can borrow and *how much* they may pay for it, *how much* they must pay their employees, *how long* and *under what* conditions they may work them, *how* they must equip their lines, *when* and *how much* they may extend their lines, and *whether* they can cut off dead and

unprofitable branches, *how* they must keep their books, and so on.

"In some respects railroad history in recent years suggests a duel. Engineering and science on the one hand have been fighting regimentation on the other, and as fast as onerous conditions have been imposed, efforts have been made to reduce such burdens by employing new equipment and methods. *How long* this contest of science and law can be kept up remains to be seen."

Some years ago a gentleman from Wisconsin convinced *himself,* the *public,* and *Congress,* that a large proportion of railroad capitalization was water and he effected legislation whereby an estimated $100,000,000 was appropriated by the government, for railroad valuation and, in June of the current year, an appropriation of $350,000 was asked to get further figures. And yet, when compilation of valuation figures indicated values greater than capitalization, it was expected that the gentleman from Wisconsin would feel rather ashamed to think he had been instrumental in spending our government's money to prove he did not know what he was talking about, but to the contrary, he claimed to have been used very shabbily, as valuation experts had placed current values on railroad holdings, whereas they should have used valuations as of 1913 and, had these figures been used, his original contention would have been proven.

Henry Ford about four years ago bought a railroad and immediately he indicated to the press that railroad operation was to be put on a most efficient operating basis; old established rules of operation were to be disregarded and an entire new system evolved that would make railroading as great a financial success as automobile manufacturing. If you recall, he kept the press busy with his plans and prophecies and yet, after four years of endeavor, a clipping from the Chicago Tribune of March 21, 1924, says, "A report by the committee on public relations of the Eastern Railroads declares Henry Ford's railroad, the Detroit, Toledo & Ironton, has lost its owner $98,207 in the four years of operation and that there had been a great deal of misinformation printed about the railroad, and many false conclusions, editorial and otherwise had been drawn. The loss incurred despite the fact that between 1920 and 1923 the movement of automobiles increased from 14,000 tons to 1,271,000 tons. If figures quoted as to tonnage are correct, can you conceive how so able an executive as Henry Ford failed to make his dreams come true after his rash promises to make his road an unqualified financial success? He failed to make good along practical lines as all demogogic legislators will also fail if they deal in facts and not in visions and phantasies.

The railroads of the United States are without question the most vitally essential of all commercial industries and have been the greatest factor in the progress and growth of our nation and, their reward today is abuse from unscrupulous politicians whose charges of mismanagement and double dealings have been voiced so often that the public at large, and a great number of the railroad employees, have been led to believe these charges true and have aided in obtaining restrictive legislation which is slowly but surely throttling the nation's greatest asset.

If some of this destructive legislation is repealed and railroad executives are permitted to operate their roads unhampered by so many tremendously expensive regulations, they might in time produce earnings which would again attract investors and be better able to hold their own through rate reduction against its fast growing competitors, the motor truck, motor bus and ordinary automobiles.

As an example of truck competition, an article printed in the Detroit News, Sunday, August 24 (quoting H. R. Trumbower, economist in the Bureau of Public Roads) prints a survey of conditions governing milk transportation to eight large cities, Detroit, Cincinnati, Milwaukee, St. Paul, Minneapolis, Indianapolis, Baltimore and Philadelphia. In all of these cities, with the exception of the last two named, trucks transport 90 per cent of the milk supply. Comparative statistics were given for the city of Detroit for July, 1915, and February, 1924, indicating hauls by steam roads, electric roads and motor trucks.

	July, 1915		February, 1924	
		Per cent		Per cent
Steam Roads	5,368,415 lb.	41.8	775,710 lb.	2.1
Electric Roads......	5,421,810 lb.	42.8	3,265,290 lb.	9.1
Motor Trucks	2,038,130 lb.	15.9	31,743,690 lb.	88.8

Another table was shown giving the number of trucks engaged in this service and the mileage and zones in which they operated. This table is of interest because of its denoting length of hauls and figures are as follows:

Mileage Zone	No. of Trucks	Per cent of Total
0-9	0	0
10-19	12	9.9
20-29	32	26.2
30-39	26	21.3
40-49	22	18.0
50-59	15	12.3
60-69	10	8.2
70-89	5	4.1
		100.0

Where trucks take over business formerly handled by railroads the railroad rate is adopted as the trucking charge.

From facts and figures as given, it should be apparent that truck competition is making enormous inroads on transportation formerly handled by railroads.

Railroads are accused of inefficiency and extravagance. In reply to the first charge, members of this organization are partially responsible if the charge be true, but your mere presence today and for the days to follow is a refutation of that charge as the sole purpose of our convention is the interchange of ideas, which make for greater efficiency.

The general public, however, has no idea of the handicaps which are imposed upon supervisors and over which they have little or no control. Labor organizations, particularly those of the several crafts, have not only worked a hardship upon the railroads who employ them but upon themselves, and sooner, or later will voluntarily make such changes in their various agreements as will permit certain work to be done by other than full paid mechanics. The saving thus effected can be pro-rated among the skilled mechanics performing such work as calls for skill and ability peculiar to the various trades.

A national survey of industries was made a few years ago to obtain reliable figures as to comparative wages paid railroad employees engaged in similar work and it was found that the average rate in industries other than railroads was less than that paid to railroad employees. However, it also developed that in many industries the skilled mechanic doing work requiring real skill received a much higher rate than the skilled mechanic on the railroad, but a balance was struck indicating a higher rate paid the railroad mechanic because any and all work of a mechanical nature was claimed by railroad mechanics and was paid for on a flat rate basis, whereas much of the same kind of work requiring little or no mechanical skill, was done by lower paid labor in other industries, which brought the average rate below that paid by the railroads. Because of these conditions many of the skilled railroad mechanics have permanently left the service of the railroads in order to obtain the higher compensation paid for real skill and ability in other industries.

These conditions also make for unrest among the crafts, because they know of higher wages paid and feel that they are unjustly dealt with. Other conditions being equal and if it is conceded that railroad transportation is of most vital importance to our nation's welfare and progress compensation to its employees should equal or exceed wages paid in other industries. An organization could then be effected

which is impossible under present conditions, as labor turnover, now an element most hurtful to organization, will be minimized.

As to extravagance. If the various exponents of this charge will become supervisors on one of the many railroads and function according to rules and recommendations of the material economy committee, he will surely hate and regret the fact that his vocabulary ever included the word, "extravagance," and in a short time he would hate the word "economy" with a more bitter hate than "extravagance."

Much good has been, and is being accomplished, by these committees. Many of their recommendations are seemingly of minor importance because of the small items considered but when the immensity of our railroad systems is also considered, these little savings, where made, run into enormous sums of money.

One of a supervisor's chief worries is to so handle his department that the minimum of waste and the maximum of economy is effected, thus avoiding the criticism of general officers who seemingly all are specialists on these subjects and it is surprising to note how small an article of usable material they can find in the scrap pile, and how quickly they can notice an inefficient operation.

The employees of our railroads numbered 1,879,770 in 1923 according to a report of the Interstate Commerce Commission, and if the true critical situation of the railroads could be brought to their attention in a way in which all of them could comprehend, there is no question but that much of the unrest and dissatisfaction which now prevails among them would be dissipated, and they would become a mighty factor in forcing the repeal of restrictive legislation, and the enactment of constructive or helpful legislation. President Markham of the Illinois Central is doing a great work along this line by publishing in various newspapers from time to time facts and figures, worded and compiled in such a manner, as should be readily understood by all who can read, and he invariably ends his articles by inviting constructive criticism and suggestions.

If more railroad officers and executives were to follow his example, if the government through the Interstate Commerce Commission were to challenge and deny charges made that their figures are in error, and if the country could be covered by as many forceful speakers, possessed of authentic and incontrovertible facts and figures exposing the misrepresentation which puts the railroads in a false position before the public, a wonderful change in conditions would soon be brought about. As a whole, we are a nation composed of fair minded people, but unfortunately at times it takes some terrible calamity to awaken us to an impossible condition we have allowed to obtain through indifference, and lack of interest. It is to be hoped that the public will awaken to an understanding of the railroad situation before it is too late. The members of this organization should possess themselves of all available data which can be authenticated beyond doubt and, by refutation of erroneous and hurtful charges, try and bring about a better understanding of real conditions as they truly exist on the part of our fellow employees.

Every railroad employee knows of the retrenchments that have been made in order that a reasonable financial showing could be made. He knows this because of lay-offs, shutdowns, explanations to him as to why certain tools or equipment has not been furnished, by the number of locomotives that are tied up through the fewer number of trains run, etc., and it would seem that it should not be hard to bring him to a true understanding of conditions.

I trust that our members will not understand this message as having political significance beyond my sincere interest in the railroad's welfare as I have no desire nor right, under our constitution to indicate political preferences in our proceedings. I have only touched briefly on a few of many pertinent facts of the present which will become aggravated if the near future does not bring relief.

Instead of condemnation surely much credit is due stock holders and executives for maintaining a struggle against odds which seem hopeless and may they soon by reason of right, prevail over prejudice and be permitted to operate their roads with as fair a financial return as any other essential industry. Our part in the struggle must be to exercise our mechanical and executive ability to the utmost and make for the ultimate in efficiency.

Better Terminals versus More Locomotives

By L. G. Plant

Assistant to the President, National Boiler Washing Company, Chicago

THE design, operation and maintenance of motive power should be governed so far as possible by four fundamental objectives: first, dependable design and reliable operation; second, efficiency in operating cost and capacity; third, maximum output of the most efficient motive power units; fourth, economy in the maintenance of locomotives in a dependable, efficient and productive condition.

Dependable power has always been regarded as the most vital requirement upon the motive power department. The consequences of a failure on the road are such that in locomotive construction and subsequent maintenance, operating reliability is the first consideration. No feature in design however efficient, nor maintenance practice however economical will ever be tolerated on American railroads if it impairs the ability of the locomotive to "get over the road." Those who have sought to improve motive power efficiency by the application of auxiliary devices have found that they must first provide equipment that can be depended upon to function reliably.

No saving in the cost of operating locomotive shops and terminals will justify engine failures resulting from too rigid economy in their maintenance. Nor can the time that locomotives are available for service be increased at the expense of time actually required for maintaining these locomotives in a dependable operating condition. Any permanent improvement in locomotive output must be based upon sound operating methods and better facilities for maintaining motive power in a servicable condition.

Next to reliability in locomotive operation comes efficiency. Locomotive efficiency implies more than a relation between output and the fuel consumed; it includes capacity, both in respect to the investment involved and the size and weight of the locomotive itself. Efficiency in locomotive design and condition is the next most important requirement upon the motive power department.

Operate Most Economical Units

Maximum efficiency in locomotive performance cannot be realized without obtaining the maximum output from individual locomotives. Locomotive operation should always be concentrated upon the most efficient units and the maximum output continually secured from these locomotives so that the less efficient units can be stored. This practice is an important cause contributing to the substantial reduction in unit operating costs that have been registered by a number of railroads in recent years.

Compare, for example, the situation on the Union Pacific in March, 1924, with January, 1920. The gross freight ton-mileage, excluding weight of locomotive and tender, was 1,629,127 in March, 1924, and 1,624,860 in January, 1920. slightly higher in March, 1924, but the volume of freight traffic or amount of work performed by motive power in this class of service is sufficiently similar to afford a good basis

for comparison. In January, 1920, the Union Pacific had an average of 371 serviceable freight locomotives, of which only 5 were stored. In March, 1924, this road reported an average of 459 serviceable freight locomotives on line but 184 of these locomotives were stored. In other words, the Union Pacific produced practically the same ton-mileage in March, 1924, with an average of 275 locomotives in freight service that it produced in January four years ago with 365 locomotives in this service.

It is evident that the Union Pacific could not have effected this large increase in the output of each individual freight power unit without the acquisition of more powerful and efficient freight locomotives. But it is also significant that along with the addition of these new locomotives, the railroad has pursued a systematic policy of storing the less efficient locomotives so that the average productive time of each locomotive in freight service is practically as high as it was when the number of locomotives available for service was considerably less. The Union Pacific could not have achieved its present state of operating efficiency with all its new motive power in use had it also retained the less efficient locomotives in service and allowed the average output of all freight locomotives to decline.

Too Many Locomotives—Too Few Terminal Facilities

There is a fixed "overhead" expense attached to every locomotive that continues whether the locomotive is in operation or idle. This "overhead" expense increases or drops with a decrease or rise in the traffic volume and can only be controlled through a policy governing the purchase of locomotives. Where increases in freight traffic have been met by increasing the average output of the locomotives in this service instead of placing proportionally large orders for additional motive power to handle the business, this policy has reduced the "overhead" expense for each locomotive owned. Conversely, there is no greater incentive toward increasing the individual output of locomotives owned than an actual shortage of power and some of the best examples of what can actually be accomplished in the utilization of motive power are afforded by these railroads on which motive power purchases have been restricted as a matter of policy or financial necessity.

The president of a locomotive company was recently quoted as having stated that there were too many locomotives in this country. This has no serious bearing upon the business of the locomotive manufacturers which is primarily that of replacing worn out and inefficient units with modern motive power that will save more than enough in operating costs to absorb depreciation and pay interest on the investment. But this statement is literally substantiated by a study of the actual situation that clearly indicates a greater need generally for expenditures upon locomotive terminals and other facilities for increasing the earning power of existing locomotives than for the purchase of additional motive power.

The greatest obstacle to this policy lies in the relative difficulty of obtaining funds for improvements to mortgaged property in comparison with the ease with which money can be secured for the purchase of locomotives through the sale of equipment trust obligations. A solution to this difficulty is found in the rental of improved terminal facilities from contractors who are able to install and finance these improvements on this basis.

The problem of increasing the individual output of locomotives has acquired added importance with recent increases in the cost of motive power. The modern locomotive can, in reality, be regarded as a seventy-five or one hundred thousand dollar power plant. What would we be obliged to pay for electric current in any city, if supplied by three separate power plants each operating an average of less than eight hours out of twenty-four? To make this parallel complete, let us assume that the fires under the stationary boilers are dumped after each run.

This is substantially the condition applying to the average locomotive, which can be considered a self-contained power plant on wheels. It is possible that if these three power plants were each "assigned" to an individual crew, that these men would take a greater personal interest in their "assigned" power plant, would cultivate more flower beds surrounding the building, keep the brass railings polished somewhat brighter and perhaps reduce the maintenance cost to some extent. But it is apparent that both the operating and investment expense of such an arrangement would increase the cost of electric current to a figure that would not be tolerated in any community.

The same economic laws that govern the cost of electric current generated in a stationary power plant also control the cost of tractive force at the draw-bar of the locomotive. But the conditions under which locomotives are operated make it impossible for them to maintain continuous service, at least without radical changes in design and vastly improved terminal facilities. The rack and wear of running over uneven roadbeds and the intense rates of evaporation in locomotive boilers necessitate withdrawal from service for periodic shoppings.

But with all the limitations under which locomotives are required to operate, an opportunity exists on nearly every railroad for deriving a higher return upon its investment in motive power by reducing the non-productive time of locomotives. This is the time that locomotives are not actually in operation on the road and is called non-productive because a road locomotive cannot earn any revenue for the railroad when it is standing at a terminal or in a shop. A portion of the time now spent in terminals and shops is unavoidable but a comparison of locomotive performance on various railroads shows such discrepancies in the average non-productive time of locomotives as to suggest that with the necessary facilities a considerable improvement in the utilization of locomotives could be effected by a number of railroads.

The American Railway Association now has a committee including both operating and mechanical department officials who have been appointed to deal with the problem of locomotive utilization. A sub-committee is already at work on a study of the situation on various railroads with respect to this problem. An analysis of the methods and facilities on these roads will point the way to a substantial reduction in the non-productive time of locomotives but the subject should always be viewed broadly. The analysis might otherwise become so detailed as to obscure the real issue.

Locomotive Output Both an Operating and Mechanical Problem

The question of which department is responsible for a terminal delay is not of such consequence as the magnitude of the delay itself. Attempts to register the proportion of terminal detention for which the operating and mechanical departments are separately responsible usually degenerate into a futile effort to see which department is most successful at "passing the buck." The important thing is to keep the most efficient power in operation as much of the time as possible and this is an objective in which both departments are jointly concerned.

There are a number of admirable methods for improving locomotive utilization which the work of the American Railway Association's Committee will emphasize. The most widely advertised practice is the recent extension of locomotive runs. The inauguration of "Main-Trackers" or the continuous operation of freight trains through congested terminals without changing locomotives has undoubtedly contributed to the relatively high percentage of time the freight locomotives are in service on the Baltimore & Ohio.

Another railroad arbitrarily requires its division officials to store a certain number of serviceable locomotives as soon as the average locomotive mileage for the division falls below a standard value.

Locomotive terminal and shop facilities, however, are the determining factors in respect to locomotive utilization and any comprehensive analysis of this problem must take these facilities into account. The effect of maintenance facilities upon the earning power of locomotives is more evident in the design of terminals than in the equipment of large shops. Locomotive terminal facilities not only govern the length of time that locomotives must be held out of service between each run but, with adequate equipment for current running repair work at the terminal, the length of time between heavy repairs for which the locomotive must be sent to the general shop can be materially lengthened.

Efficiency and Output More Important Than Repair Costs

It has been contended that the cost of making repairs at a number of terminals is generally higher than if this same work were concentrated at a large shop. But if the time that locomotives are available for service can thus be increased, the value of their additional earning ability should be weighed against the higher repair costs involved in making repairs at terminals. Reliability and efficiency in operation are also factors which take precedence over the cost of repairs provided this is not excessive. It is reported that one railroad on which the locomotive performance is particularly good both from the standpoint of operating efficiency and the utilization of motive power, is systematically making running repairs to locomotives each month coincident with monthly boiler inspection and washout.

The necessity for better locomotive utilization will compel improved locomotive terminal facilities that are designed for turning locomotives more rapidly and equipped for reducing the time required for current maintenance and repairs to locomotives. The locomotive terminal should no longer be regarded as a mere shelter for locomotives at the end of the run, means for turning these locomotives and for supplying them with fuel, sand and water. By increasing the output of the most efficient locomotives, the terminal can contribute indirectly, but none the less effectively to locomotive efficiency. There is also a direct economy resulting from improved terminal facilities and some types of terminal equipment can be classed as direct fuel savers, comparable in their effect to any of the numerous economy devices now being applied to locomotives. But in contrast with locomotive appliances, terminal equipment tends to reduce rather than increase locomotive maintenance costs.

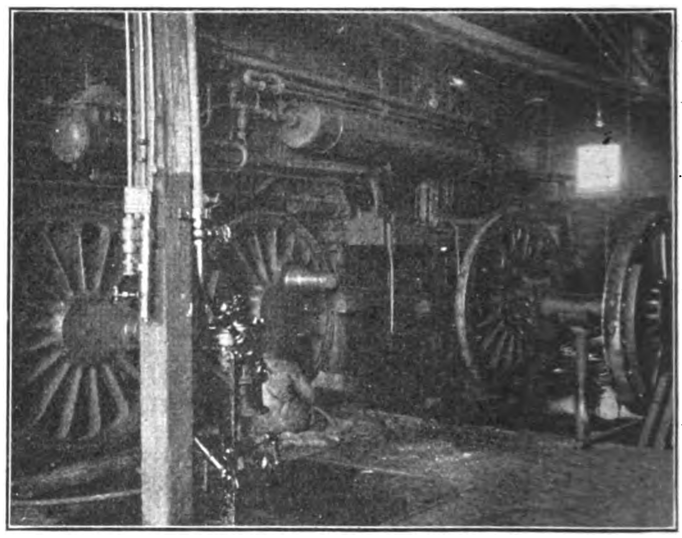
No single terminal device has a more direct effect upon locomotive utilization or has greater possibilities for improving the efficiency and capacity of locomotive operation than equipment for washing and refilling locomotive boilers with hot water together with a recent development of this system which provides for steaming up locomotives by the direct injection of steam and hot water. This will enable large locomotives to be filled and steamed up in approximately half an hour and also makes it possible to generate a working steam pressure before the fire is lighted.

Economy in the maintenance of locomotives has been referred to as the fourth objective although it is generally regarded as the first and most definite requirement upon the motive power department. In fact, the mechanical organization is often controlled entirely from a cost standpoint. This would not be so objectionable if a more logical unit than locomotive miles were applied to maintenance costs.

Ten years ago, it is recalled that only one railroad in the southeast and but few roads in other parts of the country computed fuel consumption upon a gross ton-mile basis in freight service. Fuel was then recorded upon a train-mile basis without regard to whether the figures applied to a 3,000-ton main line freight or a branch line local. All railroads now report fuel used in freight service upon a gross ton-mile basis and passenger fuel consumption upon a car-mile basis. But the statisticians still persist in basing maintenance costs upon the locomotive mile without regard to whether the costs apply to an eight-wheel "Tea-Kettle" on a regular branch line run or to a modern Mikado in a main-line pool. Unlike other necessary improvements, intelligent accounting does not require a large expenditure. True economy in locomotive maintenance cannot be achieved until the expenditures for this purpose are judged by a proper standard.

Labor Saving Devices

A drop pit jack with a hydraulic pump is illustrated. The pump was made from an old worn out 9½ in. air pump by substituting a piece of steel tubing, and two check valves for the air cylinder. This pump is located on a post and the discharge line is connected to each stall of the drop pit by suitable fittings. The water intake is connected to the enginehouse washout line. The pump is operated at the post. This, you can readily see, eliminates the hazardous condition of operating the drop pit jack down under the wheels. It also eliminates the laborious work of pumping the drop pit jack with a lever. Two men can easily do the work of four men and a great saving of time will be made, both in applying wheels, or removing wheels



Drop Pit Jack Operated by Hydraulic Pump

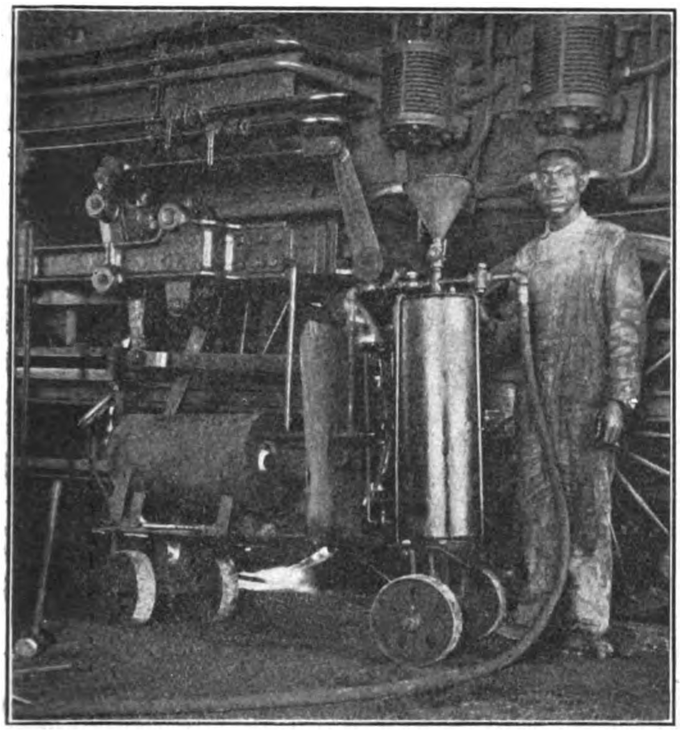
from an engine. We have a record time of wheeling a six wheel switch engine in 17 minutes. This time includes removing the covering from the drop pit before wheeling and covering it after the engine is wheeled. This arrangement does not necessitate the removal of the lever attachment of the drop pit jack, so that it can be operated in the ordinary way if so desired.

Portable Tire Heater

A portable tire heater was made with two pair of truck wheels, an auxiliary reservoir, some sheet iron, pipe fittings and valves.

It is very easily constructed, the principal feature being a pre-heating or atomizing chamber. The fuel oil is thoroughly vaporized to a gas in this chamber and it then passes to the hoop burner around the tire in a highly combustible form which results in an intense white heat being forced against the tire. As you will notice by referring to the photograph, which was taken while in operation, there

is no smoke or unburnt gases escaping from the burner. The burner is easily operated, does not require a skilful operator and will heat a tire 68 in. in diameter, 3½ in.

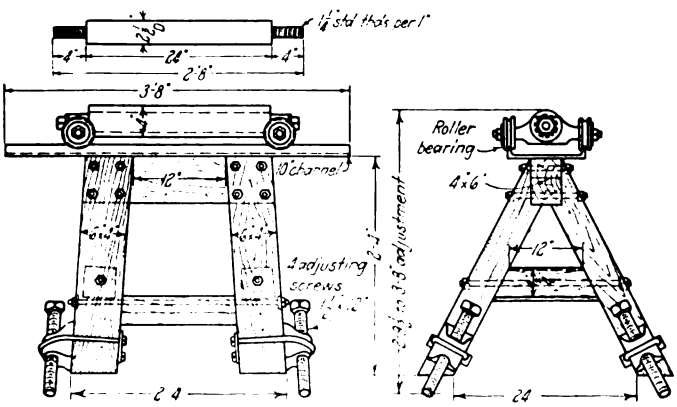


Portable Tire Heater Which Has Given Effective Service

thick in 10 to 12 minutes. Also it is absolutely safe to operate, there being no danger of explosion.

Universal Roller Support for Heavy Work

A universal roller support for supporting heavy work such as locomotive frames, etc., while being machined on a slotter is shown in the drawing. This device consists of a wooden horse, equipped with adjusting screws on the legs for adjusting for proper height, a channel iron that

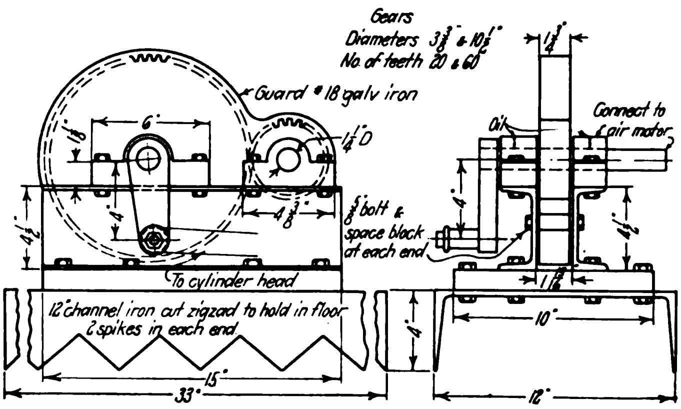


Universal Roller Support for Heavy Work

is used as a track for the wheels to roll in, and a piece of steel tubing that acts as a roller. By referring to the sketch, it can be seen that the support works in two directions which gives the slotter operator free use of his table for any motion that may be necessary in performing his work, consequently saving a great deal of time for machining any heavy work.

Machine for Grinding Cylinder Head Joints

Another drawing shows a machine for grinding cylinder head joints. This device is very simple and costs very little to construct. It consists principally of two gears, ratio 3 to 1, a crank and a connecting rod and is operated with an ordinary air motor. The cylinder head is held in place with a rod through the center with the tension of a brake cylinder release spring. An air motor operates the gear train and by means of a connecting rod. The crank arm gives a reciprocating rotary motion to the cylinder head. This

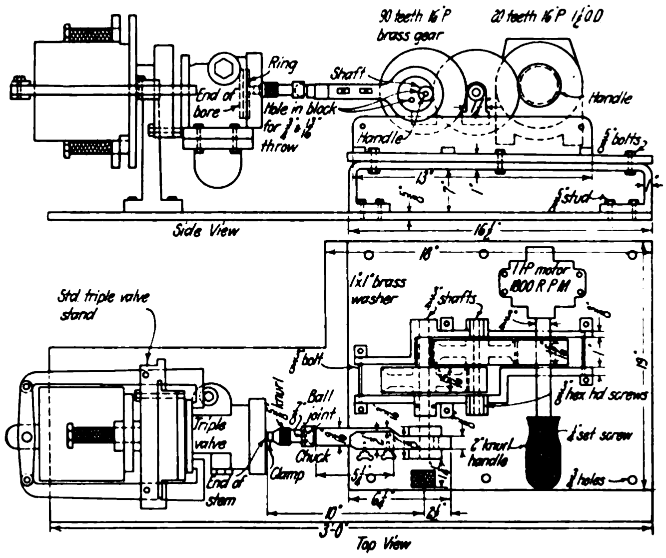


Machine for Grinding Cylinder Head Joints

machine is a great time saver for the reason that after it is set up, it requires little or no attention of the machinist until the joint is ground. Therefore, he can carry on his other work while the machine is in operation. I have seen a 9½ in. air pump used to operate a cylinder head grinder but this gear arrangement, using an air motor, is more economical because it does not use as much air to operate and is much faster.

Device for Lapping in Piston Rings and Slide Valves in Triple Valves

A device for lapping in piston rings and slide valves in triple valves is also illustrated. It is simple of construction as can be seen from the sketch and results in a great saving of time from the fact that, after it has started lapping,



Device for Lapping in Triple Valve Piston Rings

it requires no attention from the operator, who can be preparing the next triple for the lapping operation. Also, this machine does a much better job than is possible to do by hand.

The development of labor saving devices should have the same consideration as is given by the organization to the output of the shop. The supervision has learned that it pays to

organize a department where labor saving devices as suggested can be experimented with and made up ready for use, such as, air clamps and vises on drill presses, jigs and fixtures for holding various castings and forgings while performing, drilling, shaping or planing operations, where gages can be made and used for standard articles that are manufactured instead of calipers, gang tools and special taps and cutters, forming tools, special hammer dies, and a similar class of tools.

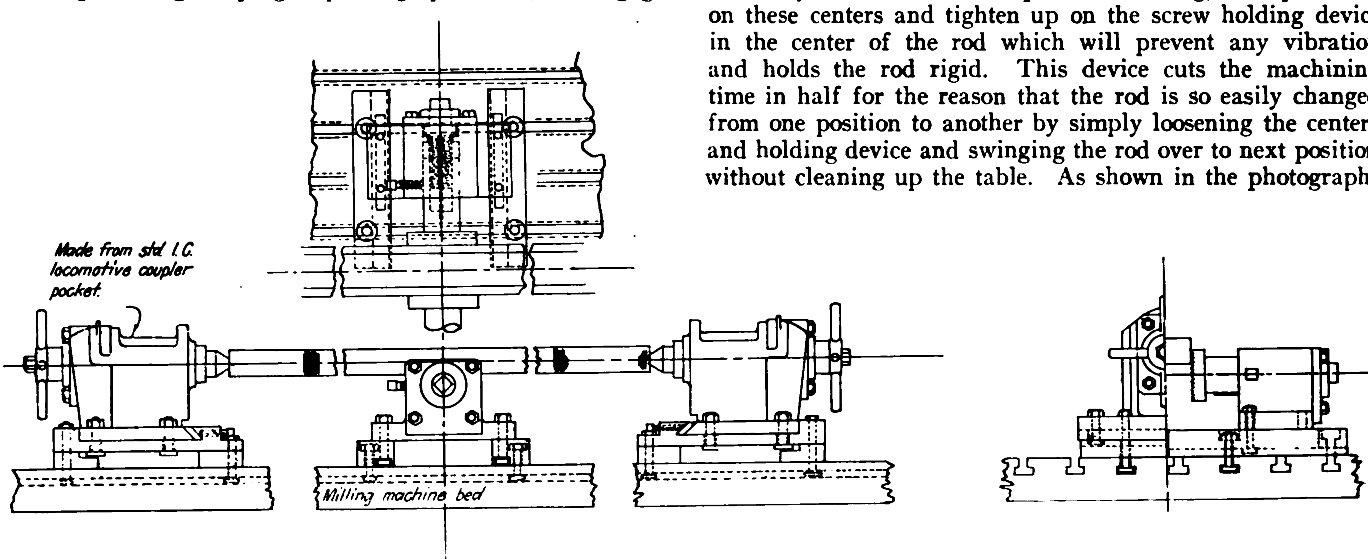
The money expended on a labor saving device should be governed by the number of articles or the amount of work to be done. In large shops it pays to expend a large amount of money on a labor saving device on account of the large amount of work, whereas in a small shop it would not pay to expend as large an amount of money.

It may happen that a suggestion is tried out and found to be impracticable and those making the suggestion become discouraged but is it not better to encourage the initiative of the organization with respect to the development of labor saving devices in shop organization so the work can be facilitated than to continue systems in the shop that close the door to progress. There is no end to the advancement and the savings which can be made by the organization who are always putting forth new ideas in connection with their work.

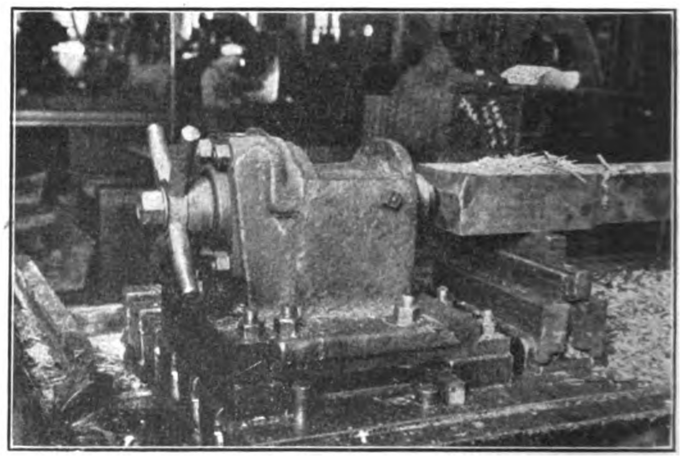
This report was read by F. W. Lauer, Illinois Central, chairman.

Chucking Apparatus for Holding Main Rods on Slab Milling Machine

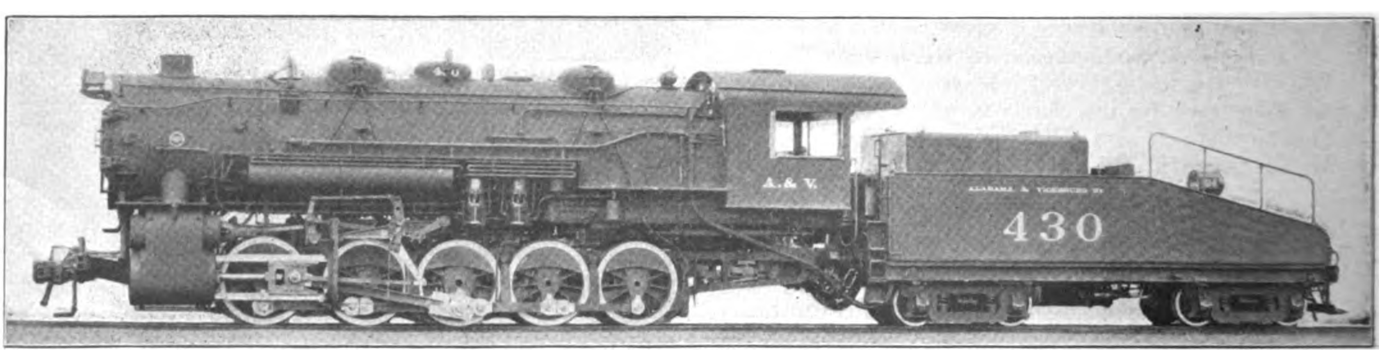
A chucking or holding apparatus for holding main side rods on a slab milling machine, while being machined is shown in two of the illustrations. This device consists of two head stocks and a screw clamp. The head stocks are very similar to a lathe tail stock and were made from two scrap coupler pocket castings. The forged rods are drilled and reamed for 75 degree lathe center. Then all that is necessary to set these rods up for machining, is to put them on these centers and tighten up on the screw holding device in the center of the rod which will prevent any vibration and holds the rod rigid. This device cuts the machining time in half for the reason that the rod is so easily changed from one position to another by simply loosening the centers and holding device and swinging the rod over to next position without cleaning up the table. As shown in the photograph, the ends of the rod may be supported by blocking up from the table, which relieves the centers from the cutting strain. These supports, however, do not interfere with the rapid realinement of the forging when changing from one face to another. The drawing shown gives a clear understanding as to how the device is fastened on the bed of the milling machine.



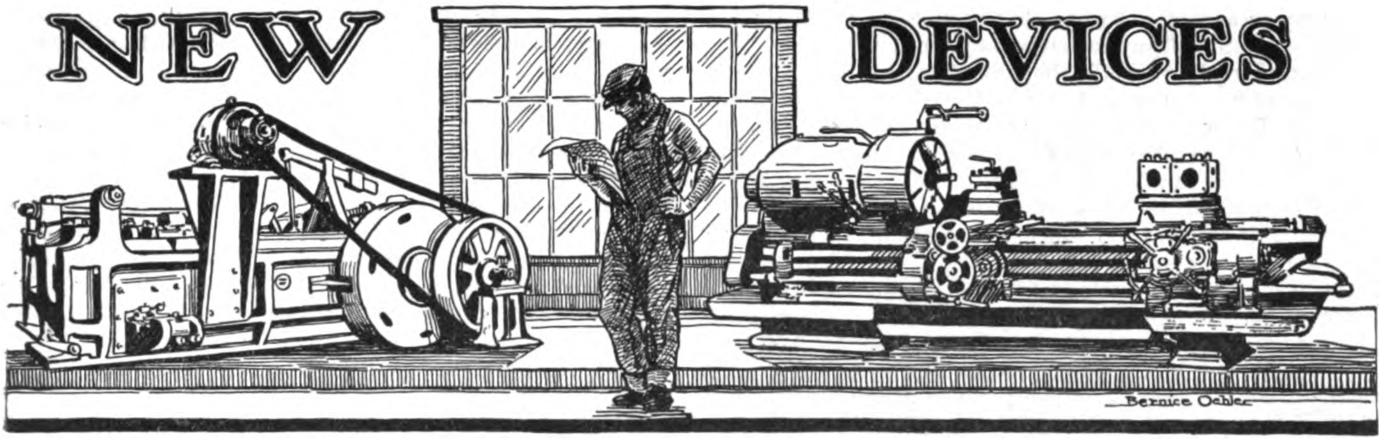
This Chucking Arrangement Is a Great Time Saver in Machining Main and Side Rods



Close-Up View of One End of Chuck for Holding Rods

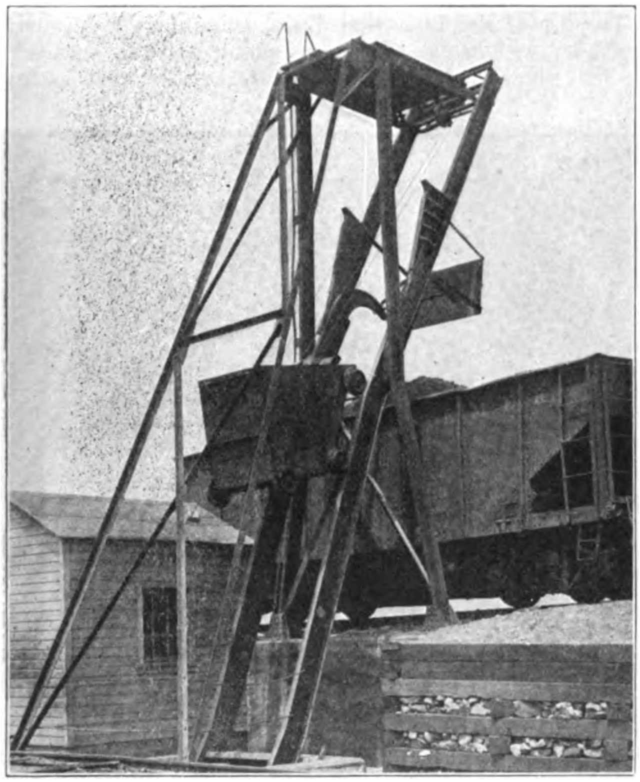


Ten-Wheel Switcher, Tractive Effort 78,200 lb., Built for the Alabama & Vicksburg by the Baldwin Locomotive Works



Electric Cinder Handling Equipment

THE economy of modern cinder handling equipment as compared with earlier methods of disposal is shown in a striking manner by a study of a Roberts & Schaefer N. & W. electric type installation which has just been made by the A. C. Nielsen Company, an independent engineering organization of Chicago, in co-operation with the railway on whose line the plant is located. This railroad does a freight business exclusively, and serves as a connecting road for several other lines. Years ago the ashes from the locomotives were removed in wheelbarrows, this expensive process being later replaced by a locomotive crane, which took the ashes from a pit beneath the track. While the crane effected a considerable saving, it was felt that the cost could be still further reduced. Satisfactory experience with two Roberts & Schaefer coal handling plants led to an investigation of the N. & W. type electric cinder plant made by the same company. This investigation indicated a large possible saving over the crane method.



This Plant Handles the Ashes from 24 Locomotives Each Day

The cinder plant was installed in the summer of 1923. It handles the ashes from 24 locomotives regularly, and does considerable work for other engines as well. As the fire is cleaned, the ashes are dumped into a hopper beneath the track, and from there they drop into a skip car having a capacity of 80 cu. ft. This car is hoisted on an inclined

SUMMARY OF COSTS AND SAVINGS

Cost of operating electric cinder plant:	
Depreciation—$8,828.56 (20 years' life)	$441.43
*Average interest at 6 per cent $\frac{21}{20} \times \frac{\$8,828.56 \times .06}{2}$	278.10
Allowance for repairs and maintenance	100.00
Fixed cost per year	$819.53
Fixed cost for 8 months—$819.53 x $\frac{8}{12}$	$546.35
Power	158.12
Direct labor	1,042.80
Supervision	260.76
Total cost for 8 months	$2,008.03
Tons handled	3,570
Cost per ton $\frac{\$2,008.03}{3,570}$	$.562
Operating cost at full capacity:	
Fixed cost per year, present basis	$819.43
Additional repair allowance	200.00
Fixed cost per year, at maximum capacity	$1,019.43
Fixed cost per day, $1,019.43 (300 days)	$3.40
Power, 100 tons at $.0443 per ton (present cost)	4.43
Labor, 24 hours, at $.44	10.56
Supervision	1.30
Cost per day	$19.69
Cost per ton $\frac{\$19.69}{100}$	$.197
Savings of electric cinder plant over locomotive crane:	
Cost per ton, locomotive crane	$1.160
Cost per ton, cinder plant	.562
Net saving per ton	$.598
Net saving for 8 months, $5.98 x 3,570 tons	2,134.86
Corresponding net saving per year, $2,134.86 x $\frac{12}{8}$	3,202.29
Net annual return on investment	36%
The electric cinder plant pays for itself in less than 3 years.	
Savings of electric cinder plant over hand method:	
Cost per ton, hand method	$2.000
Cost per ton, cinder plant	.562
Net saving per ton	$1.438
Net saving for 8 months, $1.438 x 3,570 tons	$5,133.66
Corresponding net saving per year, $5,133.66 x $\frac{12}{8}$	7,700.49
The cinder plant pays for itself in less than 14 months.	

*Allowing for interest earned by depreciation reserve.

track by means of a 15-hp. electric motor, and discharges into a standard railway car on an adjacent track.

During the eight months that this plant has been in service, repairs have amounted to $58.95, a large part of which was for electrical alterations not strictly chargeable to this account. The plant is expected to last 20 years and charges for depreciation are on that basis. Adding interest at six per cent, and including an allowance of $100 per year for repairs and maintenance, which allows for an increase with age, the total annual fixed cost is $819.53. Prorated for eight months, this amounts to $546.35.

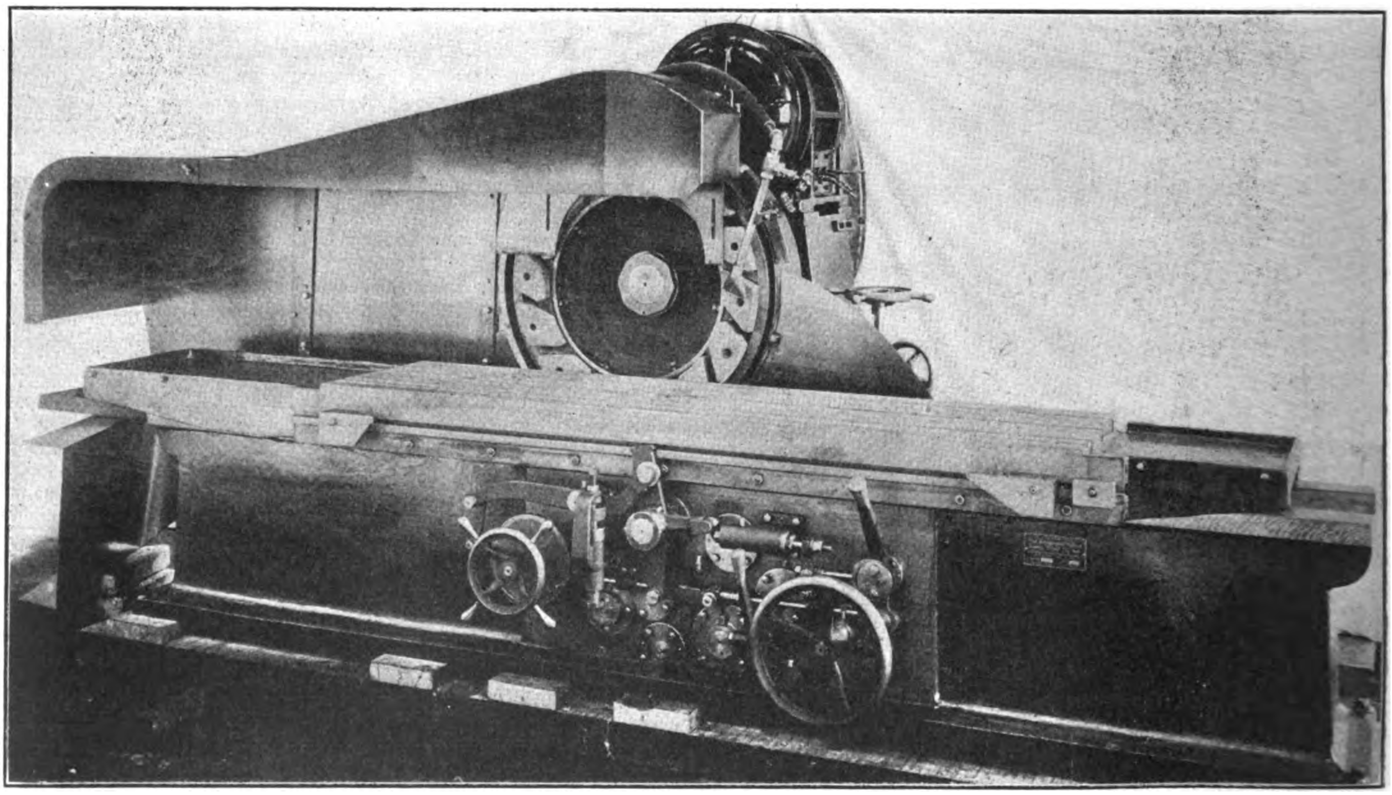
Power for the same period cost $158.12, or about $0.0443 per ton of ashes handled. Supervision cost $260.76 and labor amounted to $1,042.80, which is about equal to 10 hours a day for one man. The plant is in use during three shifts daily, but it does not occupy the full time of a man. The total cost for the period of eight months was $2,008.03, which for the 3,570 tons handled, amounts to $0.562 a ton of cinders. This cost will be decreased when the plant is given more work. To date, it has handled only about 18 tons of cinders a day, and since it can handle 100 tons, it has been operating at only about 18 per cent of full capacity. On some days, however, 50 locomotives have been cleaned, which means about 63 tons of ashes or 63 per cent of the capacity. The capacity of the plant it not limited by the size and speed of the skip, but by the time required to clean the locomotive fires, between 12 and 15 minutes being required for each locomotive. As shown on the accompanying cost sheet, the cost when operating at full capacity will be $0.197 a ton.

The cinder plant has effected an appreciable saving compared with the locomotive crane. When the crane was abandoned the cost was averaging $1.16 a ton. Since the new plant does the work at a cost of only $0.562 a ton, the net saving is $0.598 a ton, which amounted to $2,134.86 for the eight months' period. This is equivalent to $3,-202.29 a year, which is a net annual return of 36 per cent on the investment. In other words, the cinder plant will repay its cost in less than three years and as the amount of work increases, the savings will be even larger.

The hand method cost about $2 a ton in comparison with which the cost is reduced to $1.438 a ton, or $7,700.49 annually. This will pay for the plant in less than 14 months.

Bridgeport Heavy Duty Face Grinder

IN the recent development of heavy duty face grinders the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., has brought out a new and improved machine which is particularly adapted to railroad shop work such as the grinding of locomotive guides. This machine, known as the type 84 T. S., is of extremely durable construction throughout, and is designed to take the heaviest cuts without undue vibration. The drives throughout are positive as all belting has been eliminated. The general arrangement of the grinder is such that complete control and ease of operation is assured, and its compact design permits the use of a minimum of floor space.



Heavy Duty Face Grinder Particularly Adapted to the Finishing of Locomotive Guides

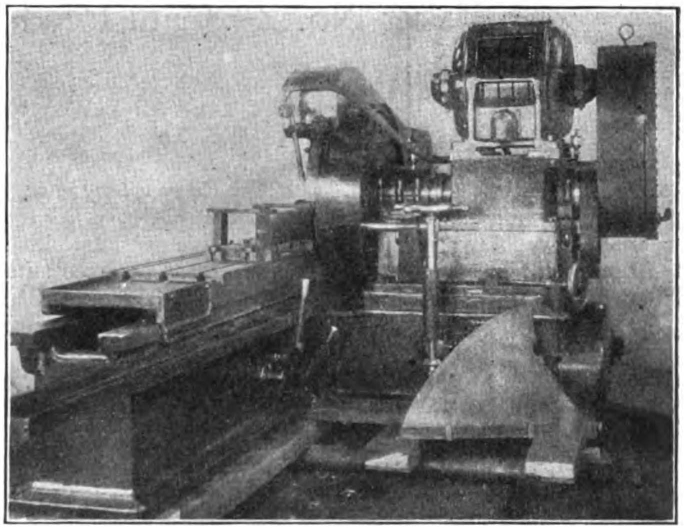
The use of the 14-section 32-in. grinding wheel provides a grinder with many advantages and economies because of the fact that the abrasive sections are adjustable so as to be taken up as they wear, are easily renewed and the space between the sections forms channels for carrying away the grinding refuse so that the cutting faces do not foul. The sectional arrangement also tends to provide a means for the cooling agent to penetrate to the cutting points and carry

away the generated heat more rapidly than with a solid wheel.

The spindle is heavy and is carried on ball bearings which resist all radial and thrust loads in each direction. Power is provided by means of a directly connected motor mounted above the spindle, and the water pump is driven as an individual unit by a separate motor.

It has been found that on this class of grinder it is necessary that the operator be able to control the machine from either the front or back. On this machine the operator is able to start, stop or reverse the carriage, as well as to control the speed, feed and flow of water from either position.

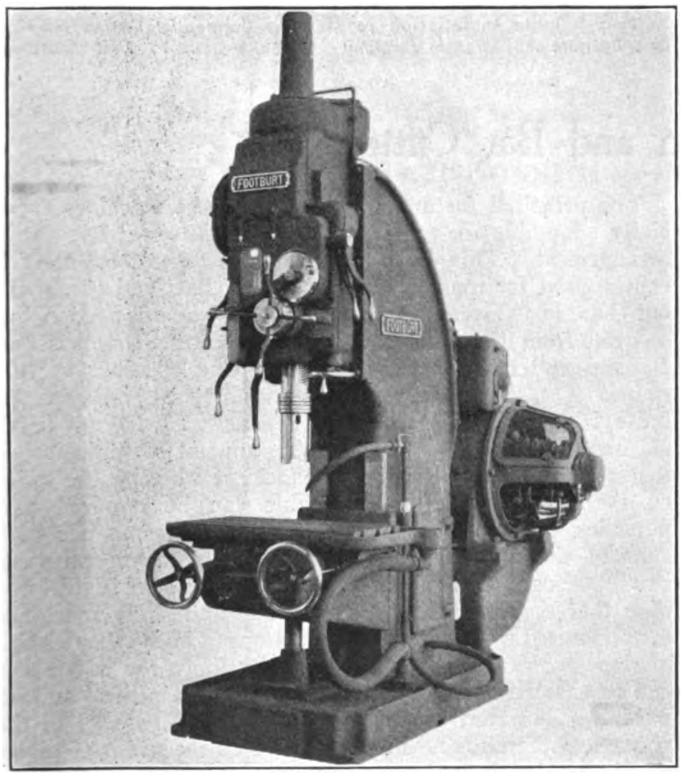
A graduated arc indicates the amount of swivel of the grinding head, which may be set for concave grinding by means of a hand wheel. An automatice feeding arrangement is provided which, together with a large range of work table speeds, makes possible the production of high quality work within limits of .0005 in. Specially designed settling tanks and a high capacity water pump assure an abundant supply of clean cool water on the work at all times. This grinder is regularly made in four table lengths from 66 in. to 140 in. with a width of 20 in. and can, if desired, be equipped with a magnetic chuck.



Bridgeport Grinder Showing Directly Connected Motor Mounted Above the Spindle

Heavy Duty Drilling Machine

A DRILLING machine which has a rated drilling capacity of 5 in. in solid steel, made possible by its rigidity of design, has been placed on the market by The Foote-Burt Company, Cleveland, Ohio. Some of the outstanding features of the machine are that the head unit can be entirely detached from the upright and that the speed changes can be easily obtained through a sliding gear arrangement.



The Head Unit, Containing All Mechanism, Can Be Detached from the Upright of This Foot-Burt Drill

The head of the machine is bolted to the face of the upright, so that the bolts are in shear instead of in tension. This assists in giving unusual strength to the head and upright construction, and tends to prevent any deflection at the point of the drill through additional rigidity secured with this arrangement.

This is a feature which is essential for production work.

Another interesting feature is that the head unit can be entirely detached from the upright, as the entire mechanism of the machine is contained in the head proper. This construction provides for a pump lubrication system, thereby eliminating the necessity of hand oiling. It also permits the removal of the complete head without disturbing the balance of the machine. This is particularly important when a number of these machines are used close together, as it is possible to remove the head holding bolts, and by hooking the crane to the top of the head, lift it from the balance of the machine without interfering in any way whatever with the machines in its vicinity.

The speed changes are obtained through a sliding gear arrangement similar to that used in the modern automobile transmission. Nine speed changes are easily obtained by manipulating the speed change levers. By transposing one set of pick-off gears, a total of eighteen feed changes can be secured. Steel gears are used throughout. With the exception of the sliding gears, which are stub-toothed, spiral gears are used, including spiral bevel gears for the main drive of the machine. With only one exception roller bearings are used throughout the machine, which reduce frictional wear to a minimum. The spindle bearing is of a high grade bronze.

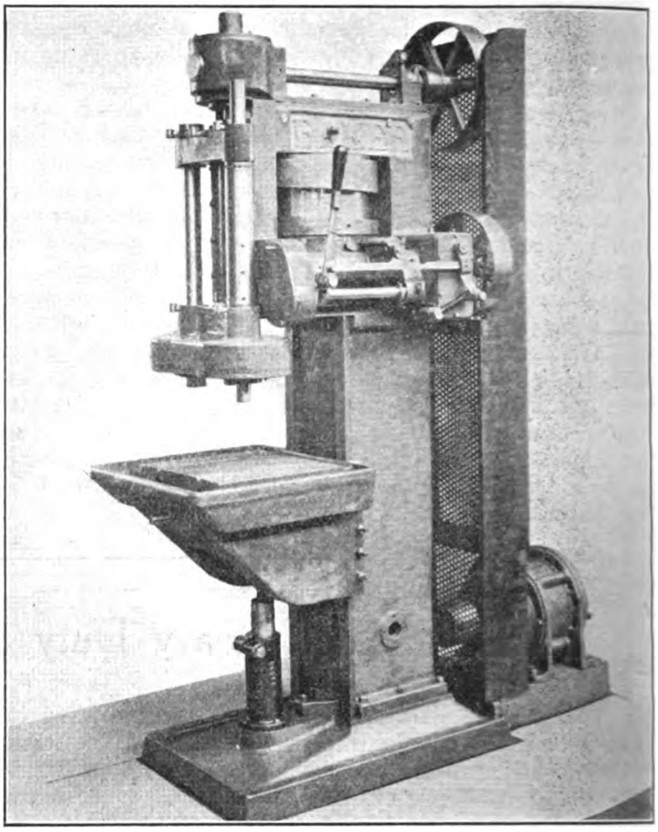
Some of the general specifications are as follows: The distance of the nose of the spindle to the top of the plain table is 35 in.; the distance of the center of the spindle to the face of the column is 18 in.; the diameter of the spindle bearing in the sleeve is 3 in.; the diameter of the spindle nose is 5 in.; the spindle is equipped with a No. 6 Morse taper; the working surface of the plain table is 24 in. by 24 in.; the table vertical adjustment is 18 in.; there are 18 feed changes from .100 in. to .140 in.; nine speed changes from 25 to 201 r. p. m.; the net weight of the machine with a plain table is approximately 10,000 lb.; with the compound table approximately 11,000 lb.

Baker No. 24 Cam Feed Drilling and Boring Machine

A CAM feed drilling and boring machine suitable for handling medium heavy work has been put on the market by the Baker Brothers, Inc., Toledo, Ohio. It is especially adapted to facing work, as the cams are designed to face to the required depth, then have a long enough dwell to completely clean up the surface, after which the spindle is quickly withdrawn. In like manner intermittent drilling can be done, the cam giving a rapid advance automatically between the holes that are to be bored or drilled. The operator has both hands free at all times for the removal and the chucking of work.

The machine is simple and is ruggedly constructed. The gears and ball bearings are made of alloy steel. It is also built with a circular full automatic indexing table. It can be furnished with a single or a double spindle. The one illustrated is a two-spindle machine for boring connecting rods. The one-spindle machine is adjustable vertically to take care of tool grinding.

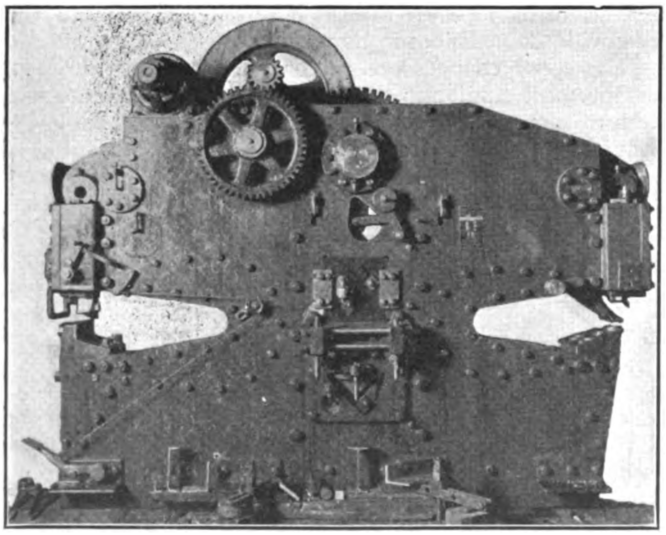
The following specifications give an idea of the size and capacity of the machine. The capacity of a single spindle using a high speed drill working in solid steel is 1½ in. per minute. The capacity is proportionate in boring or multiple operations. The spindle has a No. 4 Morse taper. The distance of the center of the spindle to the face of the lower frame is 10 in. The floor space required when driven by a belt is 28 in. by 36 in., and when arranged for motor drive 27 in. by 57 in. The maximum distance of the end of the spindle in its highest position to the table is 22 in. The size of the finished surface plain table is 15 in. by 16 in. The weight of the belt-driven machine is 2,550 lb. The feeds and speeds are furnished special for each machine. One set of cams is included as standard equipment with each machine.



A Two Spindle Installation for Boring Connecting Rods Having One Spindle Adjustable Vertically to Take Care of Tool Grinding

Combination Punch and Bar Cutter

SOME features of importance for the shop engaged in repair work, such as a locomotive repair shop where but few of the operations are standardized, are included in a new series of five sizes of combination punch, shear and special bar cutter machines manufactured by the Buffalo Forge Company, Buffalo, N. Y.



Buffalo Forge Punch and Bar Cutter Adaptable to Railroad Shop Use

The principal feature, which makes these machines especially adaptable for repair work, is the universal bar cutter arrangement. This is so designed and constructed that it can be used for rounds, squares, angles, flats and tees without changing knives. Constituting a part of this section but separate from it, are the knives used for cutting channels and I-beams and other rolled pieces requiring openings of this shape. These latter, however, are not universal and a special knife is required for each size channel and I-beam used. Of importance when a considerable amount of punching is required in the shop, is the arrangement whereby the knife on the shear end of the machine can be removed and punching tools inserted in its place. In this manner both ends of the machine can be used for punching purposes simultaneously. The shearing arrangement here is different than that on the standard punch, bar and shear machines manufactured by this company. Placement of the shear knife at right angles to the frame necessarily limits the width that can be sheared to the depth of the throat. On the standard machines, however, the knife can be placed parallel to the frame and therefore no limit is placed on the width of plates which can be sheared.

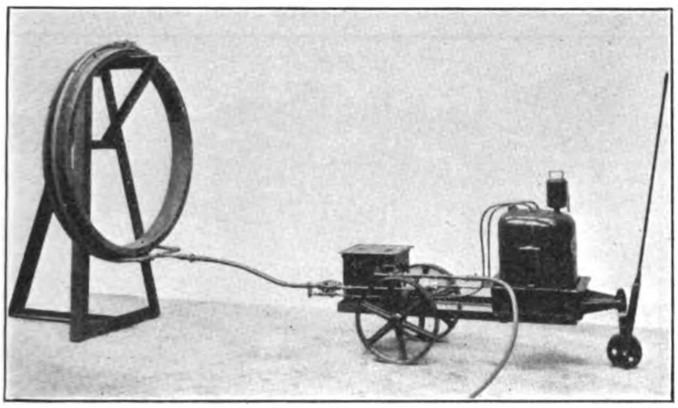
These machines are built with steel gearing throughout and with nickel-steel pinions. Because of their greater strength, the new steel gears can be made smaller, thereby saving in weight and space requirements. The machines are all equipped with a mitering arrangement for angle sections. All bearings, in addition to being bronze lined, have ample provision for oiling. The flywheel bearings are ring oiled, while the plungers are lubricated by means of oil grooves.

The method of drive may be either by pulley or by motor. The punch with these machines is provided with a gag, making it semi-floating; engagement can be made either by a handle or a foot treadle. Stops for shearing angles are adjustable to any degree desired. The frame construction is of armor plate.

The punching capacity of the new series machines ranges from 1 in. by ½ in. for the smallest size to 1¾ in. by 1½ in. for the largest size. The slitting plate capacity ranges from ½ in. to 1½ in. Other capacities such as those for squares, rounds, angles, etc., have a corresponding range of cutting.

Hauck Suction Type Tire Heater

A TIRE heater made in two halves which can be placed on the tire without dismantling the driving gear of the locomotive has recently been put on the market by the Hauck Manufacturing Company, Brooklyn, N. Y. The illustration shows the device placed on a tire which is mounted on a special frame. At the top of the heater there is an adjustment for tightening the rings to take care of worn tires of a given size. The range of this adjustment is from one to three inches. A flexible metallic hose with couplings connects the ring with the heater so that it can be placed alongside of the track.



Suction Type Tire Heater with Portable Mounting

The burner preheats the compressed air from the supply line while it is passing through the heating coil in the fire box and then through the perforated ring on the tire. Preheating takes about two minutes. Then the oil supply valve at the injector is opened and vapor is emitted from the numerous perforations in the ring. This will ignite instantly by the use of a wick torch and sharp bluish-red flames like those of a gas burner are produced. There is no pressure on the oil and kerosene or a light fuel oil may be used.

The steel tank is of 20 gallons capacity with a filler cup and strainer. The tank and the burners are connected with seamless copper tubing. The burner is attached to a standard fire-brick lined sheet steel combustion box containing a steel pipe coil. It is mounted on two 20-in. and one 7-in. wheels which have 2-in. faces.

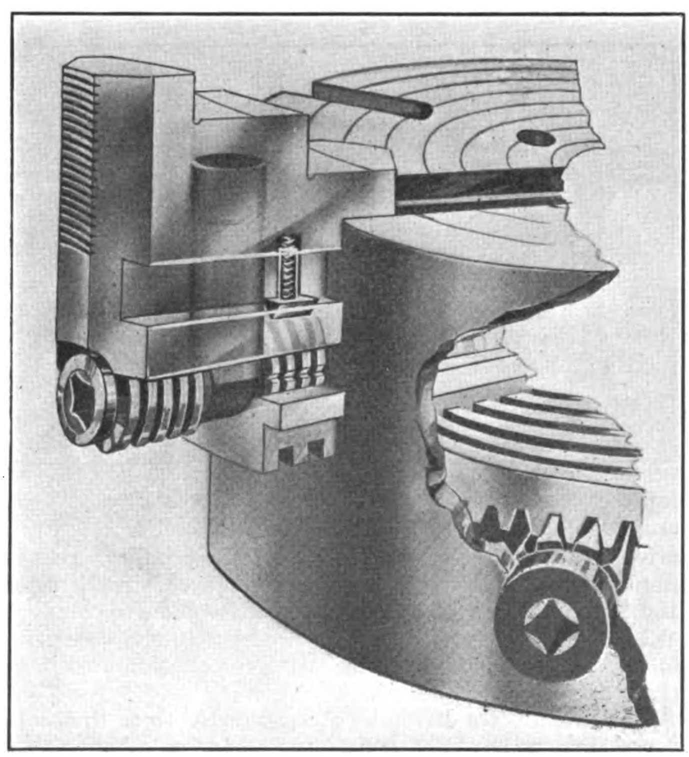
Cushman Tri-Plex Lathe Chuck

A NEW chuck has been placed on the market by the Cushman Chuck Company, Hartford, Conn., which is claimed to be the only chuck having both universal and independent movement of the jaws that indicates automatically when the jaws have found a common center.

At the base of each jaw is a hardened chrome-nickel steel screw, and a hard steel thrust bearing seated in the jaw encircles each screw. The screws engage steel racks beneath them, and the lower surfaces of the racks mesh in a scroll. When the scroll is revolved by a pinion gear, all the racks are carried concentrically forward or back.

The pitch of the screws carry the jaws on their racks exactly 1/5 in. in a full revolution. There is a V-shaped groove on each screw and in each jaw a spring index pin. As the screw is turned the index pin rides over it until it engages the groove. As the pin clicks into place after a full turn of the wrench, the operator knows he has moved the jaw exactly 0.2 in. The index pin will ride in and out of the groove without forming more than a slightly noticeable obstruction.

To change the chuck from concentric to eccentric action, turn the screw of the jaw to be adjusted with a wrench. All that is necessary to make the chuck concentric is to turn each screw whose jaw has been given an eccentric position until the index pin clicks into the slot of the screw, observing at the same time that the ends of all jaws are in approximately like relationship to the same circular observation line on the face of the chuck body. It is claimed that the chuck will then be concentrically true within .005 in. and no testing is necessary.



Lathe Chuck Which Indicates Automatically When the Jaws Have Found a Common Center

The body of the chuck is of gray iron, of one piece and formed like a truss. The jaws are of steel and, in connection with the individual racks, are reversible. All surfaces are nard, and being ground to standard gage, the jaws are interchangeable with others of corresponding sizes. The thrust bearings are self-alining and of improved design. The scrolls are of steel and the pinion gears of alloy steel and heat treated.

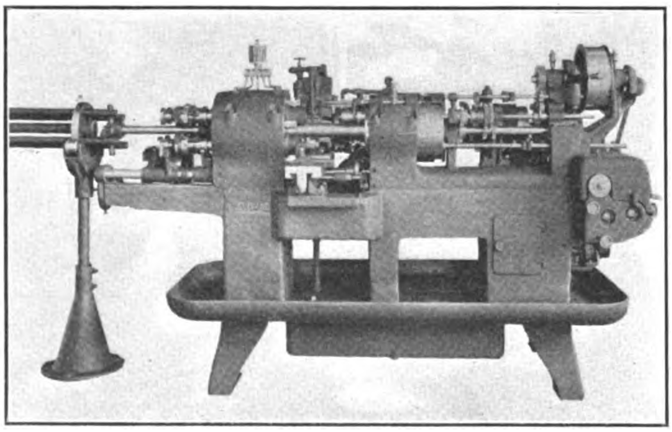
Cleveland Multiple Spindle Automatic

THERE are certain jobs which can be profitably handled on an automatic single spindle machine and there are other operations where the demand for high rates of output requires the work to be produced on the multiple spindle type. Recognizing this fact, the Cleveland Automatic Machine Company, Cleveland, Ohio, has developed a four-spindle automatic.

Certain features of the Cleveland Model A machine have been incorporated in the new multiple spindle design. This is notably true in the location and style of cams, etc. As a result, any operator who has become accustomed to operating Cleveland single spindle machines will find no difficulty in handling the multiple spindle type. With the exception of threading tools, the auxiliary tooling equipment is also interchangeable between the single and the multiple spindle machines. For companies operating both types of machines this not only simplifies the problem of handling tools, but also effects an economy through reducing investment and through keeping tools more constantly employed than would otherwise be the case.

Special attention has been paid to the elimination of all unnecessary complications of mechanical movement. As a result the mechanism is simple and all cams and adjustments have been located so that they can be easily seen and reached by the operator. Cams of different pitch and length can be used on the turret drum for handling pieces of various lengths. On the ⅞-in. size 5 in. is the maximum milling length and work up to 7 in. in length can be handled where the milling stroke does not exceed 3½ in. Where the work is of such a character that threading is not required a simplified machine can be furnished without threading mechanism.

The automatic can be arranged for either single pulley

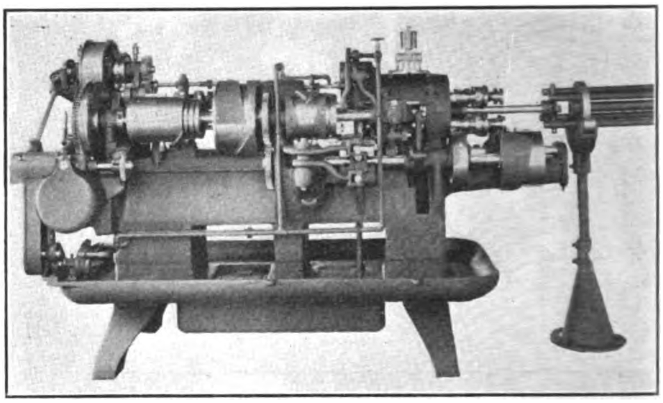


Cleveland Four Spindle Automatic

drive or electric motor drive. Where single pulley drive is employed, the pulley is 3 in. face width by 22 in. diameter and for the electric drive a 5 h.p. motor is employed, running at 1,750 r.p.m. The motor is attached by bolting a base plate to the bed arm of the machine, with power transmitted by a chain drive.

The spindles are driven by a center shaft which transmits power through hardened helical gears and seven changes of speed are provided by means of change gears. A new type of compression collar and balanced chuck operating finger are used. The chuck opening and closing slide is operated direct from the cam shaft and cams without levers, this combination providing a simple and efficient chucking mechanism. Each chuck hood is covered by an individual cast iron guard, thus protecting the hoods and preventing the cutting oil from flying when the spindles are running at high speeds.

Two slides operate the feed tubes, which are controlled direct from the cam shaft and cams without any intermediate levers, and the camming is so arranged that the tubes are always picked up by the feed slide regardless of their longitudinal position. Spring action is used for feeding the stock. The gage stop swings up to meet the bar stock as it is fed outward and then drops back out of the way. Bushings are provided to suit the reel stock tubes according to the diameter of the stock that is being handled, and the reel is rotated by means of a driver carried on a bar attached to the rear end of the spindle cylinder.



Rear View of the Cleveland Multiple Spindle Automatic

The indexing mechanism consists of a Geneva movement engaging the cylinder between the spindle bearings. Locking is accomplished by a heavy flat wedge operated by the indexing arm. A hand lever may be attached for drawing the wedge to rotate the spindle turret by hand while setting up and changing chucks.

The first and second positions are at the front, while the threading and the accelerating spindles are in the rear. This arrangement provides the maximum convenience in setting up box tools. A noteworthy feature of the tool turret arrangement is the provision of an independent tool spindle in the fourth position. By means of this arrangement, any tooling operation may be performed and completed in this position before the other tools have completed their work. The feed of this independent spindle may be accelerated or reduced to more or less than twice that of the tool turret, thus reaming or finish-turning the total length of work covered by the first and second position tools and receding from the work before the other tools have reached the ends of their cutting strokes and without delaying the operation of the cut-off tool.

Three cross slides are provided as regular equipment for the performance of rough and finish forming operations instead of the double deck posts which are commonly used: there is a fourth slide which may be used as a special attachment where it is required. The spindle cylinder is provided with individual cross slide stops for use on each spindle.

Levers are used to operate the cross slides which are short and strong and located where they are readily accessible for adjustment. Each slide has its individual cam, and can be moved to the work in any position.

The cam shaft is readily accessible for setting different cams and at the same time out of the way of chips and cutting oil. A safety pin is provided in the worm wheel which will shear off in case of any interference or overload on any of the cam movements and stop the tool turret and all of the cross slides before damage has been done.

The tool turret consists of a heavy cylinder made of hard cast iron mounted in a turret head bearing and also sliding on the hardened and ground steel center tube, which is supported in a fixed bearing back of the turret and at the opposite end in the spindle cylinder. This type of turret affords a solid tool support.

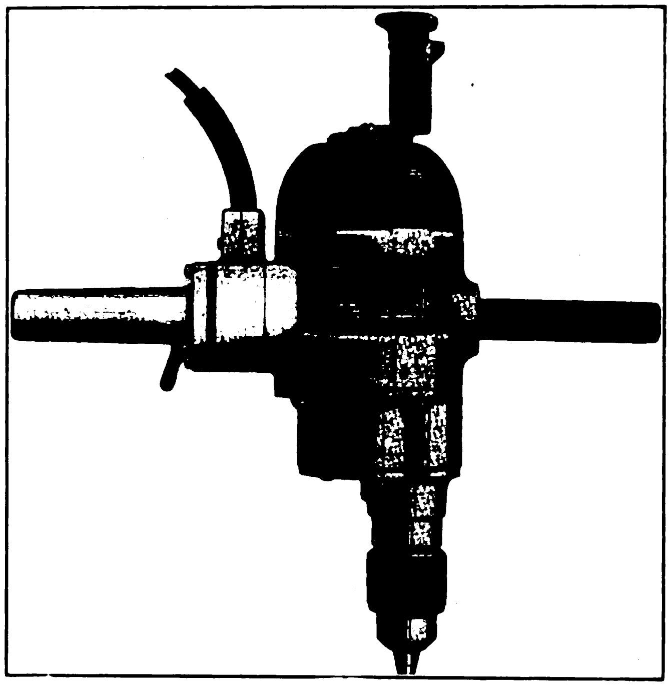
The 7/8-in. machine has a capacity for handling round stock up to 7/8 in. diameter, hexagon stock up to 3/4 in. and square stock up to 5/8 in. The floor space occupied is 36 in. by 96 in. and the weight of the machine is 4,700 lb.

Van Dorn Electric Motor

An electric motor adaptable to production and intermittent service has been added to its family of electric tools by the Van Dorn Electric Tool Company, Cleveland, Ohio. The armature is provided with an extra large shaft which runs in an oversized bearing correctly mounted. The steel bearing retainers are cast in the aluminum and provisions are made for locking the inner races to the shaft at both ends. The ends of the shaft are provided with felt washers to retain the lubricant. They are confined by steel washers to prevent them from getting into the bearing. An alloy steel thrust bearing is provided for the spindle.

The drill is controlled by a semi-automatic switch which gives a quick make and break control. It is case lined with asbestos. The insulated motor is tested and rated to meet various standardization rules and is conservative in speed. One of the features on the drill is the strong construction of the motor housing. The new design brush holders are provided with a pigtail. This eliminates soldered connections, which makes the motor easily accessible for repairs. At the top of the drill are two screws which permit the removal of the spade handle and the top head for attention to the brushes and the top bearing.

The gears are cut and hardened and assembled with ground fits and oversize keys. The armature pin is removable and is made from alloy steel. The teeth are formed to give maximum strength and smooth operation. The motor may be run on either alternating or direct current.



Electric Motor Equipped with Ball Bearings and Alloy Steel Parts Throughout

Duplex Locomotive Rod Boring Machines

The Newton Machine Tool Works of the Consolidated Machine Tool Corporation of America, Wilmington, Del., has recently redesigned and placed on the market a new type of heavy duty duplex locomotive rod boring machine. The standard machine is equipped with a plain table, but the machine is also made with an extended cross rail and auxiliary drop table at the end of the bed, which has a 4-in. in and out adjustment, thereby adapting the machine for the boring and reaming of the taper fit in crossheads.

The spindle is machined from an open-hearth hammered steel forging. The end of it is increased in diameter, which is 8 1/2 in., and is fitted with a No. 7 Morse taper hole with a key slot and a draft slot, in addition to a face keyway for driving directly at the cutting point. It is counterbalanced by a ring counterweight suspended on chains. The spindle sleeve, which is machined from a steel forging, is 6 1/2 in. outside diameter, and is fitted with bronze bushings and roller thrust bearings. It is provided with a rack for feed. Each spindle is independently operated, driven by a separate motor through the back gears and bronze spiral gear ring meshing with a hardened steel pinion which is fitted with roller thrust bearings and fully enclosed to run in oil. The bearings in the drive train are all bronze-bushed and all thrusts are taken up by roller bearings.

When the machine is arranged for constant speed motor drive, twelve changes of speed are provided by the use of a six-change gear box in conjunction with a two-speed spindle head. Six changes of feed are obtained with an even ratio of pick-off gears through a six-change sliding gear box, which are reduced through worm and worm wheel and a positive hardened steel jaw-type clutch to the rack pinion. Additional feeds are obtainable by the use of other pick-off gears which are furnished as extra equipment. In addition to hand adjustment and power down feed to the spindle, power quick return is also provided through a metal cone friction, which is operated by the same lever that engages the feed, and is conveniently located on the front of the saddle.

The driving gears are either of bronze or of hardened steel, fully enclosed to run in oil. The feed gears are either bronze or steel and the essential gears are hardened and fully enclosed to run in oil.

The spindle saddles are 35 1/4 in. in length and each is independently adjustable for positioning by a large hand wheel through reduction gears and rack and pinion, at the

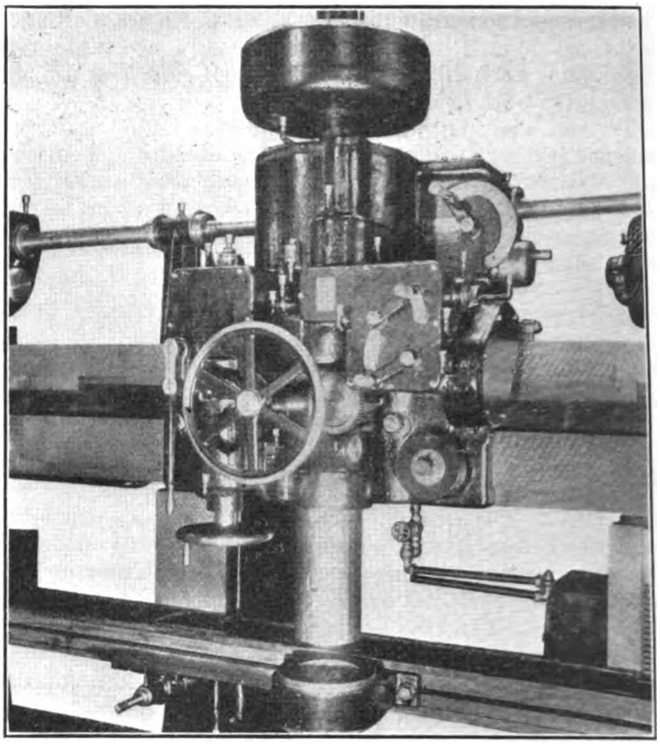
front of the head. They are rigidly clamped to the cross rail by a special form of binding gib adjusted by three bolts from the front. Taper gibs are used to compensate for wear. A one-inch pin extending one inch below the head, central with the spindle, on which is scribed a deep center line, facilitates the adjustment of the heads to exact centers by the use of either the fixed gages or trams, which are used for laying off the rods.

The cross rail is a one-piece box section casting, 21¼ in. wide overall. It is bolted and dowelled to the three columns or uprights. The uprights are of box section, 11 in. wide and 32¼ in. deep at the base, and are bolted and dowelled to each end and the center of the bed.

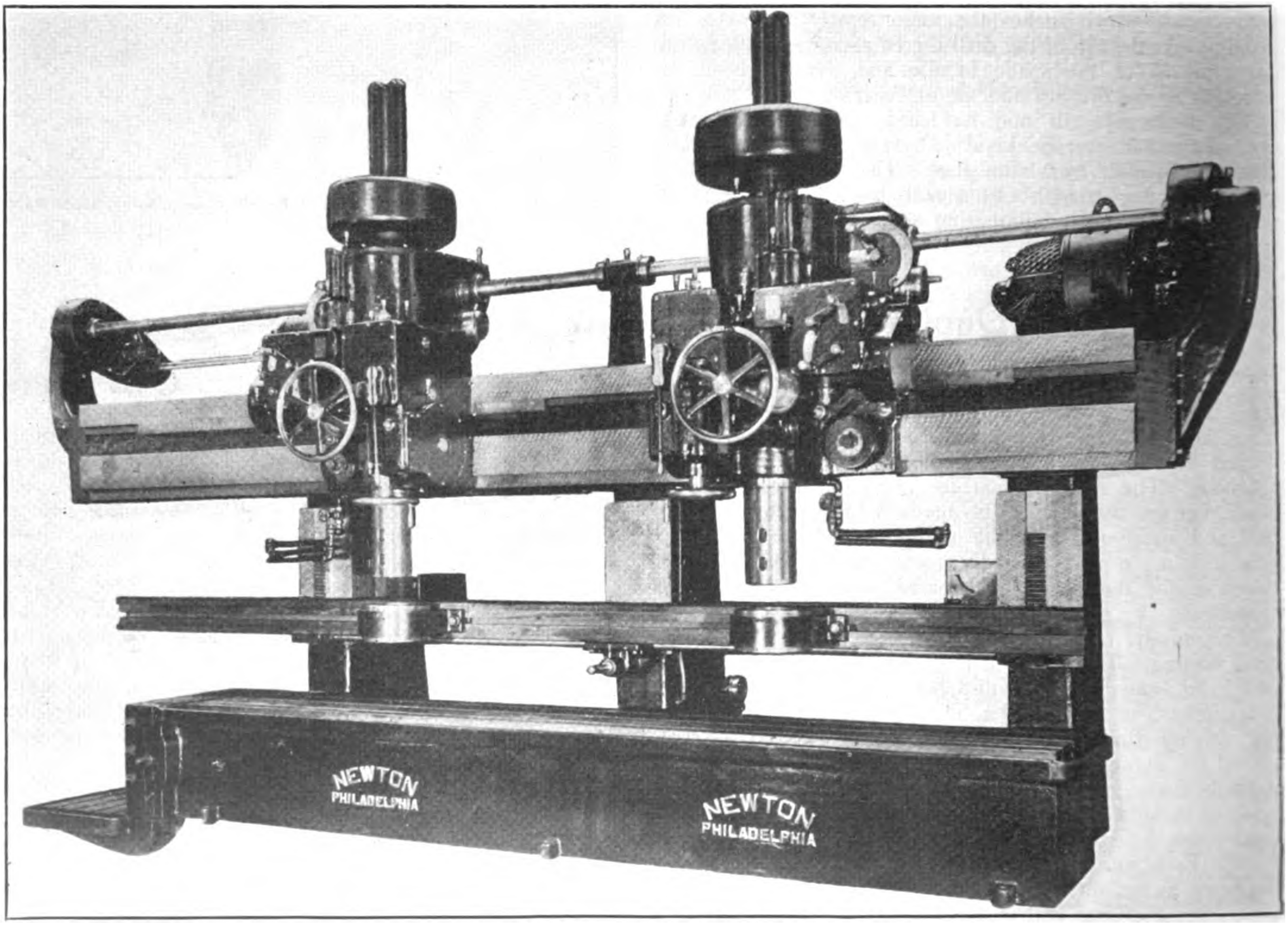
Both an intermediate spindle support and a lower arbor support are included in the standard equipment of the machine. The intermediate spindle support is in the form of an angle plate, bolted and dowelled to the saddle and resting against the under side of the cross rail, and when the spindle is positioned it is clamped to the cross rail by means of bolts fitted in T-slots. A bearing having an 8½-in. diameter hole in the bushing is bolted to this support and is adjustable vertically for varying heights of work.

A slot is machined in the center of the table, into which are fitted two bushings with three-inch holes, providing lower supports for the boring bars which are adjustable for the full length of the table. The base and the table casting is a box section, 22½ in. in height from the floor with a chip pan extending around both sides and the front, at the bottom. Inside of the base is cast a sloping wall so that the chips and lubricant gravitate to the front for removal.

When the machine is equipped with a plain table, it has a working surface 24 in. in width, 14 ft. in length, with two T-slots machined from the solid and an oil pan three inches wide and six inches deep, completely surrounding



Locomotive Rod Boring Machine Showing Construction of Spindle Saddle and Compactness of the Operating Mechanism



Duplex Rod Boring Machine Specially Equipped with Intermediate Support Bearings and an Auxiliary Drop Table at the End of the Bed

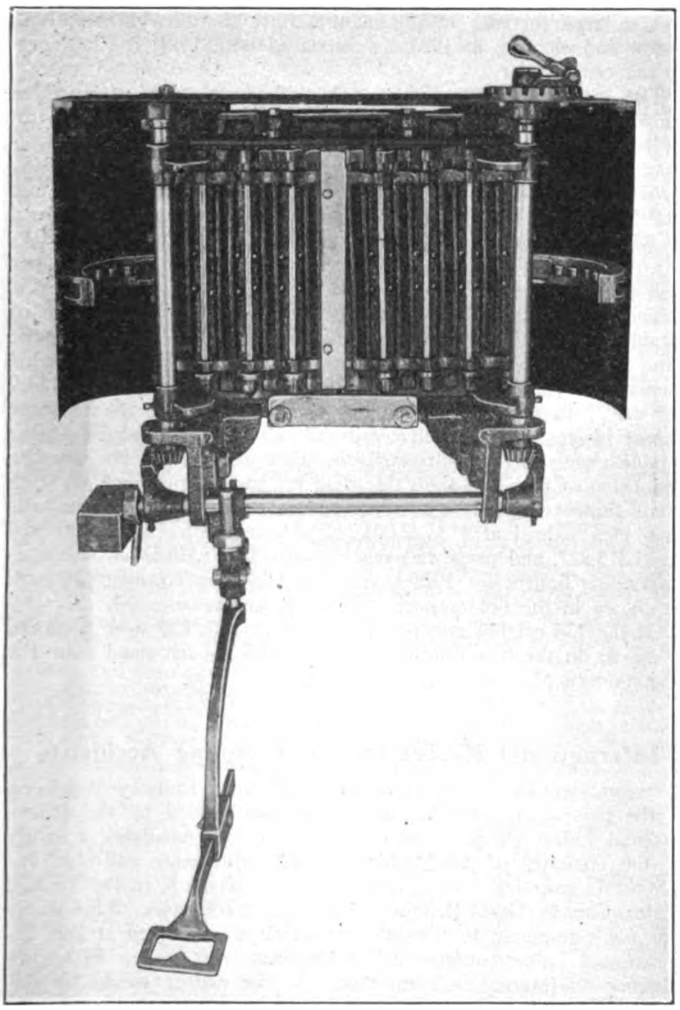
the table for draining off the lubricant. When required, an auxiliary work table, which facilitates the reaming of crossheads, etc., can be furnished. It is a one-piece casting, fitted to scraped bearings on the end of the base, and has a four-inch adjustment at right angles to the direction of travel of the saddles, with provision for clamping in position. The cutter lubricant drains from the oil pan around the table into a reservoir contained within the base, from which it is pumped directly to each spindle by a separate pump with all necessary connections furnished as standard equipment.

All operating parts, except the drive shaft on top of the machine and the spindle, are fully enclosed so that the machine will meet with the most rigid safety requirements.

When the machine is arranged for a constant speed motor drive, two 15-hp. 900 r.p.m. motors are required. They are mounted and bolted to pads on the rear of the gear boxes, to which they are directly connected by gearing. When the machine is arranged for variable speed motor drive, two 15-hp. 400 to 1,600 r.p.m. motors are required, which are mounted on the tops of the end columns and geared directly to the main drive shaft, thereby eliminating the gear boxes.

Revolving Locomotive Fire Door

A LOCOMOTIVE fire-door constructed on the principle of a roll-top desk has been designed by Frank Matthews, Montreal, Canada. It is operated by its own mechanism without the aid or use of air, steam or electricity, thereby relieving the over-taxed pressure on the air pumps.



Locomotive Firedoor Operated by Its Own Mechanism Without the Aid or Use of Air

The door is strongly and peculiarly constructed of steel and cannot be blown open by an internal explosion. The front is made of eight panels, four on either side. The inside and outside panels are made of steel. The middle plate is made of asbestos and the whole is riveted together. This construction tends to make the door cool.

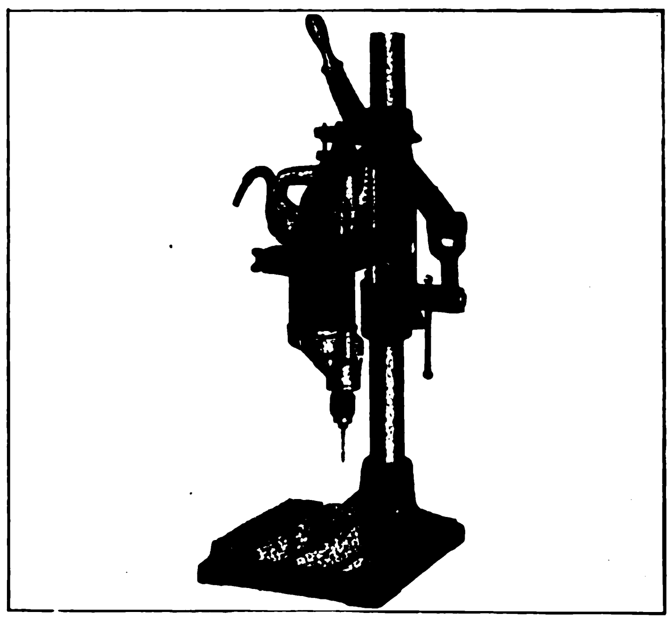
The top covering and the side wings act as deflectors, throwing the glare down to the floor of the cab enabling the engineman to see his signals more clearly at night, especially in inclement weather.

It is operated by a foot pedal entirely above and free from the deck plate, which is responsive to the slightest touch of the fireman's foot; the necessary forward movement of the body in firing causes the door to fly open. The natural backward movement of the body brings the balance weight into action and quickly closes the door. By a slight pressure on the foot pedal the fireman can open the door any desired distance in order to observe his fire. By using the hand operating mechanism at the top of the door, it can be held at any opening desired in order to observe the fire.

Hisey Bench Drill Stand

THE Hisey-Wolf Machine Co., Cincinnati, Ohio, has added to its list of portable tools a bench drilling stand equipped with a lever feed. It will hold all portable Hisey drilling machines up to and including the ⅝-in. size. The illustration shows the stand supplied with the adapter required with the ¼-in. and 5/16-in. drills.

The stand is fitted with an adjustable depth drilling stop which is convenient in producing duplicate work. The design of the stand is such that the drill can be attached without



Bench Drill Stand with a Hand Lever Feed

removing any part. The equipment consists of a portable sensitive drill press that can be operated from a lamp socket. A few of the specifications are as follows: length of feed, by means of the lever, 4½ in.; maximum distance from the top of the base to the drill chuck, 17 in.; distance from the center of the drill spindle to the column, 6½ in.; size of the base, 12 in. by 11 in.; diameter of the column, 2 in.; net weight of the stand 90 lb.

GENERAL NEWS

The Pennsylvania Railroad Club was organized on September 16 at Indianapolis, Ind., to promote fellowship among employees of the Indianapolis division. The membership takes in all classes from gang foremen to the highest operating officers. The organization work has been under the direction of Paul A. Kriese, safety agent and publicity manager of the road. The club will meet once each month.

The Safety Section of the American Railway Association proposes to have a Code of Safety Rules; and the Committee of Direction has appointed the following committee to submit a draft:—F. M. Metcalfe, superintendent of safety, Northern Pacific; H. A. Adams, assistant to general manager, Union Pacific; J. A. McNally, inspector, Wabash; M. McKernan, superintendent of safety, Missouri Pacific and W. H. Elliott, signal engineer, New York Central (Eastern lines).

Car Service Division Report

The report of the Car Service Division submitted to the Board of Directors of the American Railway Association on September 19, showed that on September 1, freight cars in need of repairs totaled 210,109, or 9.2 per cent of the number on line, compared with 175,327, or 7.7 per cent, on the same date last year. Of locomotives, 15 per cent of the number on line were in need of heavy repairs, compared with 14.7 per cent last year, and 1.9 per cent awaited light repairs, compared with 1.8 per cent last year.

Surplus freight cars in serviceable condition on September 1, totaled 231,677, compared with 66,559 on the same date last year.

Railroad Wage Statistics for June

The number of employees reported by Class I railroads for the month of June, 1924, was 1,770,565, a decrease of 163,364 or 8.4 per cent as compared with the returns for the same month last year, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total amount of compensaion decreased $29,632,263 or 11.4 per cent. While each reporting group shows a marked reduction, the principal decreases occurred in the maintenance of equipment and train and engine service groups.

Compared with the returns for the previous month, total decreased 21,939 or 1.2 per cent, and the total compensation decreased $10,533,603 or 4.4 per cent. June had one less working day than May. The employment in the train and engine service group reached the lowest point since August, 1922.

Court News

Safety Appliance Act—Locomotive in Roundhouse for Repairs.—The Circuit Court of Appeals, Sixth Circuit, holds that the Safety Appliance Act, §2, is applicable to all vehicles used on any interstate railroad, whether they are engaged in interstate commerce or not. The test of liability under this act is not to be confused with that under the federal Employers' Liability Act, where the statutory test is whether the employee is at the time engaged in interstate commerce. He is deemed to be so employed if he is working upon an "instrumentality of interstate commerce"; and a car or engine is sometimes deemed to continue to be such instrumentality, even though it is not at the present time active therein. In actions under the Safety Appliance Act the statutory criterion is whether the car is "in use" "on its line." It is therefore held that a locomotive which is at rest at a repair point after the hauling to that point has stopped is not within the act. The accident in this case happened to a machinist who fell from the engine while it was in the roundhouse by slipping on some oil which had been left on the running board after the engine had been sprayed. —Baltimore & Ohio v. Hoover, 297 Fed. 919.

Defective Coupler Not Proximate Cause of Injury.—The New York Appellate Division holds that the existence of a defective coupler, to be a basis for either negligence or a violation of the Safety Appliance Act, must be a proximate cause of the injury; and where a collision of moving cars against the car which struck plaintiff was unintended, and no part of the operation required the presence of a coupler, evidence as to a defective coupler on the car should have been excluded.—Hodgert v. D. L. & W., 202 N. Y. Supp. 793.

Safety Appliance Act—Railroad's Duty Not Affected by Strike.—The federal district court for northern Georgia holds that the impossibility of inspection and repair of cars owing to a strike and state of violence approaching war is no defense to an action for penalties incurred in using cars with defective safety appliances, the duty imposed by the act being an absolute one. Whatever the cause that prevents the making of repairs, the carrier must cease to use the cars, though its trains stop, or must suffer the consequences fixed by law. If under the unusual circumstances the penalties incurred by the letter of the law ought not to be exacted, the executive probably has the power to remit them under the provisions of U. S. Revised Statutes, §5292. The carrier must seek a remedy there.—U. S. v. Western & Atlantic, 297 Fed. 482.

Census of the Car Industry

The Department of Commerce announces that, according to the data collected at the biennial census of manufactures, 1923, there was a large increase in the manufacture of railroad cars, both steam and electric, in 1923, as compared with 1921, the last preceding census year.

The establishments engaged primarily in the manufacture of railroad cars (steam and electric) in 1923 produced 1,837 steam-railroad passenger cars, valued at $40,252,394; 164,969 steam-railroad freight and other non-passenger cars, valued at $329,672,548; 2,767 electric-railroad passenger cars, valued at $25,695,757; and 115 freight and other non-passenger electric railroad cars, valued at $488,956; together with other products to the value of $207,485,686; making a total of $603,595,341, an increase of 77.2 per cent as compared with $340,536,225 in 1921.

The combined number of cars manufactured by both classes of establishments advanced from 54,033 in 1921 to 169,688 in 1923, the rate of increase being 214 per cent; and their combined value increased from $186,903,128 to $396,109,655 at the rate of 111.9 per cent. In addition, cars, parts and repairs are made to some extent by steam and electric-railroad repair shops and by a few establishments engaged primarily in other industries. The number and value of cars and the value of parts and repairs made in such establishments in 1921 was reported as follows: 5,230 steam-railroad cars valued at $13,722,001, 179 electric-railroad cars valued at $1,313,827, and parts and repairs valued at $330,576. The corresponding figures for 1923 have not yet been ascertained, but will be shown in the final reports of the present census.

Of the 138 establishments reporting for 1923, 130 were engaged primarily in the manufacture of steam-railroad cars and 8 in the manufacture of electric-railroad cars.

International Report on Car Coupling Accidents

Automatic Car Couplings and the Safety of Railway Workers, is the title of a pamphlet which has been issued by the International Labor Office (Geneva, Switzerland), embodying a study of the statistics of fatal and non-fatal injuries to railway employees in coupling cars, through a series of years, in the United States, Canada, Great Britain and nine other countries. This study was made pursuant to a resolution which was adopted at the International Labor conference last October, with a view to seeing whether an international agreement in the matter would be desirable.

The introduction of automatic couplers on freight cars in the United States thirty years ago reduced the total annual injuries

to employees approximately 80 per cent. This is past history. The report goes on to compare present conditions in different countries, and finds that the risk to employees in Great Britain and Ireland is very much lower than in the United States, judged by the governmental reports of casualties; but in most of the countries of continental Europe, as expressed by the corresponding percentages, the risk is higher than either in the United Kingdom or in the United States. Comparisons have been made with casualties to miners and men in other hazardous industries, and the conclusion is reached that the occupational risk of men performing coupling and uncoupling operations is exceedingly high. An estimate of this risk, which seems to include all of the countries in which studies were made, gives the average as from 1½ to 2½ killed and from 50 to 60 injured, annually, per thousand shunting operators. This last term evidently is meant to include all employees exposed to risk in car coupling.

The report omits to mention the obvious fact that, so far as risk of bodily injury is concerned, the automatic couplers used in America and the non-automatic chain couplings in use in Europe are alike; in that, with neither kind of couplings are the switchmen or shunters required to go between the cars except when both of the cars to be coupled (or uncoupled) are motionless.

MEETINGS AND CONVENTIONS

International Railway Congress to Meet in London on June 22, 1925

Word has been received to the effect that the next meeting of the International Railway Congress will convene in London on June 22, 1925. It is understood, but not officially confirmed, that at the same time the British railways will celebrate the centennial of railways in that country. The program for the congress has not yet been announced.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room, 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foreman's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y. Next meeting October 9. Moving pictures will be shown on "The Three Atoms," this having to do with fuel economy; to be followed by a talk on the same subject by W. L. Robinson, superintendent fuel and locomotive performance, Baltimore & Ohio. Pictures made for B. & O. and shown at a special meeting of the International Railway Fuel Association last April.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting October 6. Paper on Air Brake Operation and Maintenance to Cars will be read by G. H. Higley, supervisor air brakes, Erie railroad.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foreman's Association.—William Hall, 1061 W. Wabash St., Winona, Minn.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Next meeting Oct. 17. A paper on public relations will be presented by R. H. Newcomb, assistant to vice-president, N. Y., N. H. & H.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal. Next meeting Oct. 16. Old timers' night. Papers on The Mechanical Department, The Operating Department, The First Peanut Butcher on the Central Pacific, and the Traffic Department, will be read by P. Sheedy, superintendent motive power, Southern Pacific; W. J. Hunter, retired superintendent, Northern Pacific; E. S. Harrison, C. B. & Q., and W. R. Alberger, vice-president and general manager, Key System Transit Company, respectively.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting October 10. Paper on Locomotive Feedwater Heaters will be read by J. M. Lammedee, Chicago.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 138 West Madison street, Chicago. Meetings third Monday in each month, except June, July and August.

LOCOMOTIVES ORDERED—INSTALLED AND RETIRED

Month—1923	Installed during month	Retired during month	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
September	384	260	64,720	2,506,469,051	7
October	408	301	64,827	2,520,200,846	15
November	333	282	64,879	2,532,085,380	14
December	333	316	64,896	2,541,607,425	14
Full year 1923	4,037*	3,672	.....	....	..
1924					
January	271	178	64,989	2,552,694,953	14
February	214	175	65,029	2,559,519,253	10
March	176	181	64,911	2,560,076,766	7
April	97	112	64,896	2,561,362,769	11
May	153	107	64,942	2,565,706,413	10
June	160	178	64,924	2,569,121,875	72
July	197	113	65,008	2,576,433,377	63

Total for 7 months, 1,268.

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment. Figure as to orders as given in first column of table is not therefore comparable with figures relating to installations given in succeeding columns.

*Corrected figure.

FREIGHT CAR REPAIR SITUATION

Date, 1923	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	2,270,405	116,697	38,929	155,626	6.8
1924					
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1
March 1	2,262,254	119,505	49,277	168,782	7.5
April 1	2,274,750	125,932	46,815	172,747	7.6
May 1	2,271,638	131,609	47,666	179,275	7.9
June 1	2,280,295	138,536	50,683	189,219	8.3
July 1	2,279,826	144,912	49,957	194,869	8.5
August 1	2,278,773	153,725	49,139	202,864	8.9
September 1	2,296,589	158,200	51,909	210,109	9.2

Month	Cars repaired: Heavy	Light	Total
June	121,077	2,451,758	2,572,835
September	114,064	2,335,161	2,449,225
October	117,254	2,444,118	2,561,372
November	104,761	2,214,617	2,319,378
December	87,758	2,073,280	2,161,038
January	76,704	2,083,583	2,160,287
February	70,056	2,134,781	2,204,837
March	77,365	2,213,158	2,290,523
April	75,352	2,074,629	2,149,981
May	73,646	2,130,284	2,203,930
June	70,480	1,888,899	1,959,379
July	72,347	1,567,430	1,639,777
August	71,863	1,420,482	1,492,345

SUPPLY TRADE NOTES

The Southern Wheel Company, St. Louis, Mo., will enlarge its branch plant at Nevada, Ga.

George C. Billman has been elected president of the Charles C. Young Manufacturing Company, Jersey Shore, Pa.

Brinton Welser, assistant secretary and assistant sales manager of the Chain Belt Company, Chicago, has been elected secretary.

A. J. Stott, who has not been active in business for the past few years, is now affiliated with the Glidden Company, Cleveland, Ohio.

Gordon H. McCrae, manager of the London office of the Independent Pneumatic Tool Company, has been elected a vice-president of the company.

Hughes & Graul, 1313 Peoples Gas building, Chicago, have been appointed northwestern representatives of the Davis Brake Beam Company, Johnstown, Pa.

The Ohio Brass Company, Mansfield, Ohio, has moved its Philadelphia, Pa., office from the Witherspoon building to 1404 Packard building at Fifteenth and Chestnut streets.

R. W. Payne has been appointed southern sales agent of the Verona Tool Works, Pittsburgh, Pa., with headquarters at 613 Fifteenth street, N. W., Washington, D. C.

The Whiting Corporation has given a general contract to T. D. Hobson & Son, Harvey, Ill., for a one-story power house, 75 ft. by 75 ft., at Harvey, Ill., estimated to cost $40,000.

The Standard Stoker Company, Inc., New York, has recently opened a sales office at Richmond, Va., and W. R. Williams has been appointed district sales manager in charge of the new office.

J. W. Blackford has joined the sales force of the Torrington Company, Torrington, Conn. Mr. Blackford will handle the sale of that company's Dayton swaging machines and Torrington ball bearings.

B. N. Broido, who has been doing special consulting work for the Superheater Company, of New York and Chicago, has recently been appointed chief engineer of the industrial department of the company.

H. D. Rohman, of the R. C. S. Equipment Company, New York, has taken over the agency of the Electric Arc Cutting & Welding Company, Newark, N. J., for Taperod electrodes on interstate steam railways.

Clayton R. Burt, president and general manager of the Austin Machinery Corporation, Chicago, has been elected general manager of the Pratt & Whitney Company, Hartford, Conn., to succeed Bryant H. Blood, resigned.

The National Railway Appliance Company, of New York, with offices at Boston and Washington, and the Hegeman-Castle Corporation, of Chicago, have been appointed general sales agents of the Walter tractor snow-plow.

J. C. Shepherd has been appointed assistant general manager of sales of the Kansas City Bolt & Nut Company, with headquarters at Kansas City, Mo., and J. W. Anderson has been appointed assistant general manager of sales.

The Hanna Engineering Works, Chicago, is now represented in Minnesota, North Dakota, South Dakota, Iowa and the eastern portion of Nebraska by the George M. Kenyon Company, 116 East Fourth street, St. Paul, Minn.

The Southwest Sales & Equipment Company, Los Angeles, Cal., has been appointed representative for the Orton & Steinbrenner Company, Chicago, to handle the latter's products in southern California, Arizona and New Mexico.

The De Remer Blatchford Company, Railway Exchange building, Chicago, has been appointed direct mill representative for the Lockhart Iron & Steel Company, Pittsburgh, Pa., manufacturers of locomotive staybolts and engine bolt iron.

The George M. Kenyon Company, 116 East Fourth street, St. Paul, Minn., now represents the Hanna Engineering Works, Chicago, in the states of Minnesota, North Dakota, South Dakota, Iowa and the eastern portion of Nebraska.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, manufacturers of hollow and solid staybolts, has appointed the Tabson Company as its special representative in Illinois, with offices in the Railway Exchange building, Chicago.

The Butler Railway Supply Company, 122 South Michigan avenue, Chicago, has been formed to manufacture and sell side bearings, trucks and truck parts. The incorporators of the company are Vincent J. Burry, C. A. Woodman and O. S. Flath.

H. L. Woolfenden, district manager of the Allis-Chalmers Manufacturing Company, with headquarters at Denver, Colo., has resigned to take charge of sales promotion of the Scott Valve Manufacturing Company, with headquarters at Detroit, Mich.

Raynard F. Bohman is now general traffic manager of the Heywood-Wakefield Company, Boston, Mass. Mr. Bohman was formerly traffic manager of the Lloyd Manufacturing Company, Menominee, Mich., a subsidiary of the Heywood-Wakefield Company.

The Commercial Asbestos Corporation has been incorporated at Huntington, Ind., to manufacture railway installations and other asbestos products. The incorporators are E. W. Steinhart, Ft. Wayne, Ind., C. J. Higgins, Detroit, Mich., and R. J. Evans, Wabash, Ind.

L. P. Mercer, resident sales manager of the Parkesburg Iron Company, with headquarters at Chicago, has been appointed Chicago district representative of the Hall Draft Gear Corporation, with offices at 343 South Dearborn street, Chicago, and will hold both positions.

The Union Railway Equipment Company, Chicago, on September 16 discontinued its sales arrangement with the Commonwealth Supply Company, Richmond, Va., and in future all sales in the southeastern territory will be handled direct from the general office, Chicago.

The Transportation Devices Corporation, Indianapolis, Ind., manufacturers of automatic cut-off control for locomotives, has appointed the Lyman Tube & Supply Company, Ltd., Montreal, as its Canadian representative. This company has branch offices in Toronto and Vancouver.

The Pawling & Harnischfeger Company, Milwaukee, Wis., has appointed P. H. Sackett to represent the company in Minnesota, North Dakota and South Dakota. Mr. Sackett's headquarters will be at 3445 Hennepin avenue, Minneapolis, Minn., and he will handle all of the company's business in the territory stated above.

E. R. Mason, 1845 Grand Central Terminal, New York City, has been appointed district sales manager, in charge of sales in all the New England states, also in New York, New Jersey, Pennsylvania and Delaware, for Fairmont Railway Motors, Inc., Fairmont, Minn., manufacturers of section gang and inspection motor cars.

The E. L. Essley Machinery Company, Chicago, has taken over the exclusive agency in the Chicago and Milwaukee districts for the sale of the line of milling machines manufactured by the Rockford Milling Machine Company, Rockford, Ill., and the Sundstrand stub lathes and the Sundstrand manufacturing lathes made by the Rockford Tool Company, Rockford, Ill.

Percy M. Brotherhood, first vice-president of Manning, Maxwell & Moore, Inc., New York, is now consulting engineer; Frank J. Baumis, works manager of the Putnam Machine Company at Fitchburg, Mass., has been appointed vice-president of Manning, Maxwell & Moore, Inc., in charge of the machinery department, with headquarters at New York, and Augustus Wood, who was chief engineer, is now works manager of the Putnam Machine Company, with headquarters at Fitchburg.

The American Refrigerator Transit Company has awarded contracts to Johns-Manville, Inc., New York, for hair material, and to the Celotex Company, of Chicago, for Celotex material, to be used in the insulation of 2,000 refrigerator cars. The Celotex material, in sheets one-half inch thick, will be applied to both the inside and outside of the framing of the side and end walls. It was erroneously reported in the September issue of the *Railway Mechanical Engineer* that the contract for all the insulating material was awarded to the Celotex Company.

The Waugh Draft Gear Company, Peoples Gas building, Chicago, manufacturer of draft gears and buffing devices, has been reorganized and its name has been changed to the Waugh Equipment Company. J. M. Waugh, president of the Waugh Draft Gear Company, has been elected chairman of the board of directors of the Waugh Equipment Company, and A. J. Tizzini, president of the Railway Improvement Company, New York, has also been elected president of the Waugh Equipment Company.

H. T. Heath has been appointed western department manager of the Hegeman-Castle Corporation of Chicago, owned and controlled by the National Railway Appliance Company of New York. Mr. Heath graduated from the Ohio State University in 1911, with degrees of M.E. and E.E. He served with the Westinghouse Electric & Manufacturing Co. for six and one-half years and joined the Economy Electric Devices Company in 1917 as sales representative of the middle west and southwestern territory.

The Ryan Car Company, Chicago, heretofore controlled by James M. Hopkins, president of the Ryan Car Company and chairman of the board of directors of the Camel Company, and W. W. Darrow, vice-president of the Camel Company, has been acquired by a syndicate, headed by John M. Burnham & Co., Chicago. William M. Ryan, formerly president of the Ryan Car Company and president of the Youngstown Steel Car Company, Niles, Ohio, has been elected president of the new company, and R. D. Bartlett will continue as secretary-treasurer and assistant to the president. T. H. Goodnow, vice-president of the Ryan Car Company, has resigned to become vice-president of the Camel Company, with headquarters at Chicago.

D. R. Arnold, whose appointment as vice-president of the Union Metal Products Company, with headquarters at Chicago, was announced in the August issue of the *Railway Mechanical Engineer,* was born in Dayton, O., and in 1906 entered the employ of the Barney & Smith Car Company, Dayton, O., where he held various positions. In 1911 he resigned from the sales department to become assistant to the chief engineer of the Canadian Car & Foundry Company, Montreal, Que., and in 1914 was transferred to the sales department. In 1916 he was appointed sales manager, which position he held until his recent appointment.

D. R. Arnold

H. P. Anderson has been appointed mechanical engineer of the Standard Stoker Company, Inc., with office at Erie, Pa. Mr. Anderson has had considerable experience in designing, pattern, foundry and machine shop practice. He is a graduate of Drexel Institute, Philadelphia. He served as mechanical engineer for four years with the Baldwin Locomotive Works, for one and one-half years with the Erie Railroad and for eleven years as mechanical engineer of the Wabash, from which road he went to the Missouri-Kansas-Texas as mechanical engineer. Mr. Anderson was promoted to superintendent of motive power and later mechanical assistant to chief operating officer, which latter position was abolished at the termination of its receivership.

P. R. Drenning has been retained by the Rogatchoff Company, Baltimore, Md., as consulting engineer and as sales manager in southern territory. Mr. Drenning was born at York, Pa., in 1891, is a graduate of the Baltimore Polytechnic. After serving as draftsman for the Baltimore Car & Foundry Company, he spent 11 years in the engineering and sales departments of the T. H. Symington Company. In July, 1923, he became vice-president of the Boyden Steel Corporation, in charge of engineering and sales. In July, 1924 he resigned to engage in consulting engineering, with offices at 902 Standard Oil building, Baltimore, where he is now located. He will continue as consulting engineer for the Boyden Steel Corporation, in addition to his duties with the Rogatchoff Company, in marketing the Rogatchoff crosshead adjustment.

TRADE PUBLICATIONS

Die Heads.—Land-Matic die head installation views are featured in a 12-page booklet recently issued by the Landis Machine Company, Waynesboro, Pa.

Power Reverse Gear.—The Ragonnet power reverse gear, Type B, is illustrated and described in detail in Bulletins Nos. 227-A and 228-A, recently issued by the Franklin Railway Supply Company, New York.

Chains and Gears.—A 224-page catalogue, completely listing chains, sprockets and gears for elevating, conveying and the transmission of power, has been issued by the Stephens-Adamson Manufacturing Company, Aurora, Ill.

Valve Gears.—In order to facilitate the maintenance of Baker locomotive valve gears, the Pilliod Company, Swanton, Ohio, has issued a 79-page parts catalogue. The various types of Baker valve gear are illustrated, and each of the parts entering into their construction is numbered for easy reference when replacing worn or broken members.

Leakage Indicator.—The Westinghouse Air Brake Company, Pittsburgh, Pa., has issued circular No. 1072, descriptive of its leakage indicator for 3-T triple valve test rack. The principle employed in this testing device is the balancing of a static head of a column of water against the pressure built up in a definite size chamber into which leakage from the triple valve is entering.

Packing Problems Solved by Wireless.—A four-page Mystic Oracle, by means of which enginehouse packing problems may be readily solved, has been issued by the Garlock Packing Company, Palmyra, N. Y. The disk on the third page of the folder is turned until the question to be answered is directly under the pointer, "What Packing Should Be Used." The folder is then closed, and the magnetized arrow on the outer page finds the answer.

Feed Water Heaters.—A 20-in. by 43½-in. chart illustrating through colors the principle of utilizing waste heat for preheating boiler feedwater through the medium of the Elesco non-contact feed water heater, has been issued by the Superheater Company, New York. A facsimile of the chart also is shown on Folder A. Two other folders, B and C, discuss in concise form the advantages of heating boiler feed water and illustrate units of Elesco equipment and various installations.

Electric Fans.—A comprehensive review of the use of electric fans for blowing, exhausting, ventilating, cooling and drying is contained in a 16-page booklet just issued by the Buffalo Forge Company, Buffalo, N. Y. The subject matter is confined to direct connected units, including descriptions of small disk or propellor fans, multiblade type fans for heating and ventilating, stoker units, pressure blowers, mill exhausters and electric forge blowers, and is amply illustrated with views of installations in various industries.

Pneumatic Tool Repair Parts.—A complete repair part catalogue showing each part that enters into the construction of Thor pneumatic tools and the interchangeability of parts from one tool to another, has been published by the Independent Pneumatic Tool Company, Chicago. Considerable tabulated matter, giving symbol numbers, name and description of part, and showing the different sizes of Thor tools on which parts interchange, has been compiled in order to give the pneumatic tool user a better understanding of the parts in the various tools and thus enable him to keep a tool in service that might otherwise have to lie idle awaiting repair parts from the factory.

Electrical Equipment.—"Electrical Equipment for Railroad Shops" is the title of publication No. C-1661, which is being issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It contains pertinent information and general principles, serving as a guide in the selection of electrical equipment for engine and car shops, engine terminals, freight terminals and passenger stations. The results of the application of individual motor drive and the extensive use made of magnetic control, both automatic and semi-automatic, in railway shops are described in detail and by illustrations. A description of the arc welding process and its uses in track reclamation is also given.

PERSONAL MENTION

General

E. GELZER, mechanical engineer of the Chicago Great Western, with headquarters at Oelwein, Iowa, has resigned.

FRANK J. REGAN has been appointed fuel supervisor of the Northern Pacific, with headquarters at Duluth, Minn., succeeding Melvin Montgomery, deceased.

T. E. MCDONALD, road foreman of engines of the Pennsylvania, with headquarters at Logansport, Ind., has been transferred to the office of the general superintendent of motive power at Chicago.

H. P. ALLSTRAND, master mechanic of the Chicago & North Western, at Boone, Iowa, has been promoted to general supervisor of efficiency, with headquarters at Chicago, a newly created position.

D. H. JENNESS, acting assistant road foreman of engines of the Fort Wayne division of the Pennsylvania, has been promoted to road foreman of engines of the Logansport division, with headquarters at Logansport, Ind., succeeding T. E. McDonald.

Master Mechanics and Road Foremen

W. H. HALSEY, master mechanic of the Chicago & North Western, with headquarters at Belle Plaine, Iowa, has been transferred to Boone, Iowa, succeeding H. P. Allstrand.

Car Department

WILLIAM J. CAIN, for the past 18 years a foreman in the car department of the New York Central at West Albany, N. Y., has been retired. Mr. Cain, who was born in Albany in August, 1854, had been in the employ of the New York Central for 43 years.

Shop and Enginehouse

HARRY LAUGHLIN, enginehouse foreman of the Pennsylvania at Elmira, N. Y., has been transferred to Sharpsburg, Pa.

J. F. HUNT, JR., gang foreman of the Pennsylvania at Elmira, N. Y., has been appointed motive power inspector of the shops at Meadows, N. J.

OTTO BURGERT, general foreman of the Pennsylvania at Rose Lake, Ill., has been appointed enginehouse foreman, with headquarters at Effingham, Ill. The position of general foreman at Rose Lake has been abolished.

Purchasing and Stores

J. E. BOGAN has been appointed division storekeeper of the Missouri Pacific, with headquarters at Nevada, Mo.

W. O. MCCLELLAN has been appointed division storekeeper of the Missouri Pacific at Coffeyville, Kans., succeeding C. W. Krumm.

L. L. STUDER, division storekeeper of the Missouri Pacific, with headquarters at Osawatomie, Kans., has been transferred to Kansas City, succeeding J. J. Fogarty.

C. W. KRUMM, division storekeeper of the Missouri Pacific, with headquarters at Coffeyville, Kans., has been transferred to Osawatomie, succeeding L. L. Studer.

J. J. FOGARTY, division storekeeper on the Missouri Pacific at Kansas City, Mo., has been promoted to district storekeeper, with headquarters at De Soto, Mo., succeeding J. E. Bogan.

CLYDE COCKE, assistant purchasing agent of the Norfolk & Western, with headquarters at Roanoke, Va., has been appointed purchasing agent, succeeding J. H. Clemmitt, deceased. Mr. Cocke was born on July 13, 1893, and entered the employ of the Norfolk & Western as a messenger boy in the summer of 1909. The following winter he attended the National Business College in Roanoke, returning in June, 1910, to the Norfolk & Western as a clerk in the purchasing department. In April, 1917, he was furloughed for military service and after two years' service overseas with the Rainbow Division, he resumed his duties in the purchasing department. In August, 1922, he was made chief clerk to the purchasing agent, and in April of this year he was promoted to assistant purchasing agent.

Obituary

WILLIAM AIRD, well known in railway and locomotive circles in Canada, died at Barrie, Ont., last week. He was born in Scotland and received his early education in France. Coming to Canada with his father, who was employed in the construction of the Victoria bridge at Montreal, Mr. Aird entered the Point St. Charles (Montreal) shops of the Grand Trunk. Later he became shop foreman at Stratford, Ont.; then master mechanic. Later he resigned that position to become superintendent of the Canadian Locomotive Works at Kingston, Ont., a position he held until his retirement ten years ago.

CHARLES R. COUCHMAN, who resigned as assistant purchasing agent and general storekeeper of the Pere Marquette in 1920 to become purchasing agent for the Detroit City Gas Company, Detroit, Mich., died suddenly at his summer home in Amherstberg, Ont., on August 16. Mr. Couchman entered railway service in 1892 as a messenger boy in the stores department of the Flint & Pere Marquette (now the Pere Marquette), and later became storekeeper at Port Huron and Saginaw, Mich. During the war he served as tie and timber agent for the Pere Marquette, Grand Trunk and the Ann Arbor.

WILLIAM GARSTANG, who retired as general master car builder of the Cleveland, Cincinnati, Chicago & St. Louis and the Peoria & Eastern in December, 1913, and who for the past several years has represented the Gould Coupler Company at Indianapolis, Ind., died in Indianapolis on September 12. Mr. Garstang at the time of his retirement had been in active railway service for 50 years in the mechanical department and had been connected with the Master Car Builders' Association and the Master Mechanics' Association for about 35 years. In 1894 and 1895 he was president of the Master Mechanics' Association. He served on the committees that adopted the M. C. B. standard car axle, journal box, journal brass, journal wedge and standard wheels. He had also served for many years as chairman of the Committee on Standard Wheels. He designed and contracted for the Cleveland, Cincinnati, Chicago & St. Louis shops at Beech Grove, Ind., and the work was carried out under his supervision in addition to his other duties. Mr. Garstang was born on February 28, 1851, in England, and was educated in the public schools. In 1862 he was a water carrier for the contractors on the laying of track from Fort Erie to Niagara and in December, 1863, entered railway service as a machinist apprentice at Cleveland, Ohio, where he remained six years, on the Cleveland & Erie, which later became part of the Lake Shore & Michigan Southern. During this time he went to night school and studied mathematics and mechanical drawing. He subsequently served consecutively for 11 years as machinist and general foreman of the Atlantic & Great Western and the New York, Pennsylvania & Ohio; for three years as general foreman of the Cleveland & Pittsburgh division of the Pennsylvania; for five years as master mechanic of the Cleveland, Columbus, Cincinnati & Indianapolis, which later became the Cleveland, Cincinnati, Chicago & St. Louis; and in 1888 he was appointed superintendent of motive power of the Chesapeake & Ohio. On April, 1893, he was appointed superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, remaining in that position until February, 1913, when he was relieved of a portion of his duties and served mainly in an advisory capacity, with the title of general master car builder, until his retirement in the following December. During his long railway service he had been closely identified with the progress made in railroading. His constant desire for additional knowledge and his aggressive activities in his chosen field of endeavor tended to keep him active and young in spirit.

W. Garstang

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Completing the Machine Tool

When a railroad buys a machine tool, it has, practically speaking, not purchased a complete tool at all, but merely the transmission by means of which mechanical power may be delivered to the cutting tool, and a foundation sufficiently rigid to support satisfactorily the object on which the cutting tool is to operate. These machines have possibilities for output and economy in labor time the full realization of which is the real object for which they are purchased. Before these possibilities can be realized, however, much ingenuity must be devoted to the development or selection of facilities for holding the work, to the proper tooling, and in some cases to both. It is generally admitted that it would be folly to attempt to develop a substitute for these highly specialized machines in the railroad shop. When it comes to the tooling, however, including the proper selection of jigs and fixtures, many roads depend on the ingenuity of the men in the shop, notwithstanding the fact that these men are not specialists and that they must necessarily go over much that is old ground to the manufacturer. The latter, in the interest of making the best possible showing for his machine, is constantly scheming to determine the most effective method of utilizing it in the performance of a wide range of operations, and what he has to offer is generally the cumulative result of years of development, just as is the machine itself. The interest of the purchaser in securing the largest possible return from his investment in the machine tool demands that he give at least as careful consideration to those facilities required to make the tool complete as he does to the selection of the machine itself. He has not fully served this interest until he has thoroughly investigated the possibilities for service in recommending or furnishing these extra facilities which the manufacturer himself has to offer.

The Value of Service Literature

Practically every shop man is familiar with the improvements which are constantly being made in the design and construction of machine tools. He may not know just how these improvements are brought about, but if he can visualize a large research laboratory where engineers experiment with new ideas, he will see a large scrap pile which is the last resting place of unsuccessful experiments. But from out of this effort and material comes one improvement after another, which tends to make this particular scrap pile an index to progress. In order to make the results of such work available to others, the data and information obtained is compiled and published in the form of instruction books, or what is generally known as trade literature. This type of literature is not new. In fact one expects it to come with a milling machine or locomotive stoker, as it does with an automobile or washing machine. Sometimes it is read and sometimes it is not. Perhaps such carelessness is due to the memory of some earlier trade publication which seemed to contain only information which was neither needed nor wanted. Yet, as better machine tools are being built, so are the instruction books and various other kinds of service literature improving.

This fact has been brought to our attention in the report of a large machine tool manufacturing company, which has spent a considerable amount of money and devoted many hours to improving its instruction books, part lists and other printed material, classed as service literature. It has given this work an important place in its research and publicity departments and as a result it is able to furnish complete and reliable information on any subject relative to its machine tools. This service makes it easier for the man who has to run the machine and also procures better results for his employer.

What has been said in this particular case is true for many manufacturing concerns. The data and information contained in service literature is not only the result of research work but it is based on the experience of many customers as well. Such material is invaluable to the railroad shop man.

Main Objective in Locomotive Repair Work

It is advisable that locomotives be handled quickly through repair shops and engine terminals in order that they may be returned to revenue service as soon as possible and also that the labor cost of repair operations may be reduced to a minimum. Continued pressure for reduced shop operating costs, however, may be productive of highly undesirable results unless at the same time it is made clear that the quality of material and workmanship entering into the repair of locomotives is now and always will be of even greater importance.

This point was strongly emphasized by H. T. Bentley, general superintendent of motive power and machinery of the Chicago & North Western, in addressing the International Railway General Foremen's convention held at Chicago, September 9 to 12. Mr. Bentley said, "Thoroughness in doing necessary work to locomotives in shops will probably reduce the shop output somewhat but materially improve the service and decrease the cost of enginehouse maintenance. Slovenly and improper work increases failures on the road and is not an economical proposition notwithstanding records of low costs in the shops." In other words, it is not so much *how quickly* locomotives can be put through repair shops, but *how long* these locomotives will stay in service after leaving the shops.

Obviously the attitude of shopmen, gang leaders and foremen toward the quality of their work is a reflection of the attitude of the general foreman, shop superintendent and higher mechanical officers. If any shop management places its record for output ahead of its record for thorough going, reliable repairs, inferior locomotives are bound to be turned out. For example, suppose that after a locomotive is wheeled, the right main wheel is discovered to be 1/16 in. or possibly 1/8 in. ahead or back of its proper position, due to an error in lining the shoes and wedges. The erecting shop foreman in charge of that engine has two options. He can drop the

wheels, make the necessary changes in the right main shoe and wedge either by means of shims or by waiting until a new shoe and wedge can be planed to the proper dimensions, the main wheels then being placed back under the locomotive. The other option, and the one which will be chosen by the average foreman on whom too much pressure is brought for output, will be to overlook the error, or at least take care of it temporarily by adjusting rod lengths. What is the result? This locomotive is placed in service and perhaps in a single week develops sharp flanges which necessitate tying up the locomotive at an enginehouse while tires are being turned or in some cases renewed.

There are always some men in any organization who will do just as poor work as they can get away with and there is need for a continued check, therefore, on the quality of locomotive repair work in order that locomotives may be maintained in condition for safe and efficient operation. Honesty is the best policy in railroad shop operation as in all other lines of business and shop foremen must be encouraged to place the proper emphasis on high grade workmanship, always correcting the errors which are bound to occur occasionally, and not trying to fool themselves and their superiors by covering up defective workmanship.

Competition for Foremen

The foreman, under the most efficient form of organization, forms the keystone to the arch. If his strategic position is not recognized and if full advantage is not taken of it, then the organization is sure to suffer and to function at a low efficiency. "The Shop Man," published by the Michigan Mutual Liability Company, recently published the following material about the foreman:

THE FOREMAN

By a Corporation President

Some people think
The president of a
Corporation has to
Know a tremendous lot.
But take it from
Me, he don't. I know,
Because I'm one,
And I know that
When an important
Matter comes up I
Always send for the
Vice-president, and
He sends for the general
Superintendent, and he
Sends for the department
Superintendent. The department
Superintendent sends for
The foreman. "Bill," says he,
"What shall we do and how?"
Does Bill send for any one?
Well, I guess not! Bill knows.
That's why the foreman
Has such an important
Job. He's got nobody
To ask. He just has
To know the answer.
If anybody asks
Me who runs our
Corporation. I answer,
THE FOREMAN.

There has been a considerable change in the status of foremen on the railroads in recent years. The loyalty and ability shown by many of these men in the crisis two years ago was in some instances responsible for this. Then, too, there has been a growing consciousness of the importance of the foreman in industry, as well as on the railroads, for the past several years. To focus attention on this development and emphasize it, the *Railway Mechanical Engineer* is offering a first prize of $50 and a second prize of $35 for the two most constructive articles on the opportunities and responsibilities of foremen which may be received at our office in New York on or before December 1, 1924. The first announcement of this competition was made in our October issue, page 578. It is not so much our intention to develop information as to detailed methods and practices, as it is to illustrate the strategic position occupied by the foreman and his opportunities for strengthening the organization and making it function more efficiently.

Suggestions for Future Conventions

Six conventions of minor mechanical department officers were held in five consecutive weeks in Chicago beginning the last week in August and extending through the month of September. In order that the papers and discussions presented at these conventions might be available to railroad men as early as possible the *Railway Mechanical Engineer* made a special effort and included a considerable proportion of each convention report in its October issue, holding certain papers for the November and subsequent issues. The convention reports referred to and their location in the October *Railway Mechanical Engineer* are as follows: Traveling Engineers' Association (page 578 to 594), Chief Interchange Car Inspectors' and Car Foremen's Association (page 608 to 613), International Railroad Master Blacksmiths' Association (page 619 to 620), American Railway Tool Foremen's Association (page 621 to 623), Painting Section, Mechanical Division (page 624 to 629), and International Railway General Foremen's Association (page 629 to 636).

The aggregate cost of these conventions to the railroads and to the supply companies maintaining exhibits is large and yet most progressive railroad officers consider the expense justified. It is hard to put a dollars and cents value on some of the returns from convention attendance such as increased general knowledge of the best practice on other roads, the broadening influence of meeting other experienced, practical men in the field and the educational value of studying new machinery and equipment developments first hand. The fact cannot be denied, however, that in many a case, a master painter, car foreman, traveling engineer or other railroad man carries home from the convention two or three new, intensely practical ideas, the application of any one of which in his own particular department saves the railroad many times over the cost of sending him to the convention. This man in some cases (we hope they are few) has been compelled to pay his own expenses, except transportation, and to lose the time while away from his job.

Strong belief in the general value of the minor mechanical associations mentioned does not imply that their conventions cannot be improved. In fact the *Railway Mechanical Engineer* has heard specific criticisms of two of the association meetings, a brief mention and consideration of which may be of benefit in planning future meetings. These criticisms include the absence of advance papers, sessions too short or only one session a day, superficial discussion, lack of encouragement to bring out opinions of quiet members and lack of definite action regarding standards of practice.

There can be no question as to the advisability of providing advance copies of the papers to be presented, otherwise the discussion is almost sure to be superficial. The practice of handing six or eight blue prints of a device about the convention floor and then reading a paper referring to the blue prints has little to commend it. It is doubtful if mechanical department men, accustomed to more or less continuous, active effort, can sit down in a smoke-filled

room and concentrate on a given subject for more than two or possibly three hours. On the whole, it would seem more advisable to have one relatively short session in the morning and another in the afternoon rather than to try to complete the work in a single long morning session. Investigation shows that four of the six associations hold two sessions a day, while the other two hold only single sessions. One point must never be forgotten and that is that the conventions are intended primarily for business, and the members should be willing to work at least as many hours in the convention hall and among the exhibits as they do on their regular jobs. None of the associations can long survive if their members, coming from points as far distant as California and Florida spend three hours a day discussing business and amuse themselves or are entertained the rest of the time.

It is of course true that many association members do not feel equal to the task of expressing themselves on the floor. If they failed to make themselves heard at any of the conventions this year, however, it was not for lack of opportunity afforded them by the chairman. In most cases they are permitted to submit written discussions, after returning home, for inclusion in the proceedings.

Much can be said on both sides of the question of adopting recommended standards of practice. Presumably such standards would be put in the form of recommendations to the Mechanical Division. Too great standardization has a deadening effect and tends to reduce the general average of efficiency. On the other hand, there is a vital need of more uniform practice in some essentials and a more general knowledge of the best practices of the various roads. The real function of the specialized mechanical associations is in the spread of this knowledge. For example, some roads report great success with a certain device; other roads do not use it. A determined effort should be made by the association interested to bring together all possible information regarding this device, outline limiting conditions, and in this way prevent one road adopting a device which has been proved a failure on another.

It is to be hoped that the officers of these associations when planning for their 1925 conventions will outline constructive programs, spend every effort to secure men who are interested and competent to present papers on the various subjects and give a great deal of thought to enabling those who attend the conventions to obtain the maximum benefit from the time expended. Almost without exception the association memberships are far below the desired point and active membership campaigns should be inaugurated during the coming year. Get the advance papers out early and ask the members to bring prepared discussions. The 1925 conventions can be made the best attended, most instructive meetings ever held by these associations. They should be.

New Books

Pulverized and Collodial Fuel. *By J. T. Dunn, D. Sc. (Dunelm.), F. I. C., Consulting Chemist, Newcastle-Upon-Tyne, 197 pages, illustrated, 7 in. by 9¾ in. Price* $6.00. *Published by Van Nostrand Company, Eight Warren Street, New York.*

A large part of the book consists of descriptions of actual plants, involving engineering details as well as the chemical processes involved in using pulverized fuel. The author has endeavored to present these underlying principles and to give a fair account of the advantages and disadvantages, as they appear to him, accompanying the use of powdered fuel for various purposes. The first few chapters are devoted to a discussion of the combustion of coal in the lump and powdered state and a chemical explanation of the unit of heat. Crushing and forms of crushers; drying; dangers involved in drying; various types of machinery used for pulverizing and the power required to operate these machines, are comprehensively discussed in the chapter dealing with the preparation of powdered coal. The relative advantages of different systems of transporting powdered coal from the pulverizers to the storage bins are adequately explained. The various methods of burning the fuel and the best ways to handle the ash disposal are next taken up in the book. The comparative costs of operating various types of powdered fuel plants along with the advantages and disadvantages incurred in their operation are ably set forth. The last chapter deals with the general properties and manufacture of collodial fuel. The text of the book is well illustrated with drawings and photographs.

Coke and Its Uses. *By E. W. L. Nicol, 134 pages, 6½ in. by 9½ in., bound in cloth. Published by D. Van Nostrand Company, New York. Price* $5.00.

Because of the fact that existing steam boilers and furnaces as well as mechanical stokers, with a few exceptions of comparatively recent origin, have been designed upon a coal fuel basis it is conceded that coal is likely to remain the chief source of heat and power. The use of coke, however, has attracted much attention, and in this book the author, who has had many years of specialized experience in adapting coal-fired steam boilers and other heating apparatus to the use of coke, has presented in non-technical language a practical treatise on coke production and its application as fuel not only to steam power plants and large steam generating units but to domestic use as well. The possibilities of the use of coke as fuel and the relative efficiency as compared with coal has been given a thorough discussion. This volume contains 12 plates and 22 illustrations in the text showing the general arrangement as well as details of design of coke-burning installations.

Condensed Catalogues of Mechanical Equipment—1924-1925 *758 pages, 8¼ in. by 11¼ in. Flexible binding. Published by the American Society of Mechanical Engineers, New York. Price* $5.00.

The fourteenth annual volume of the Condensed Catalogues of Mechanical Equipment presents to the mechanical engineer, executive or purchasing agent a valuable source of comprehensive information. The catalog section contains 527 pages of data describing the products of 430 firms, an increase of 60 firms as compared with 1922 edition. This section, in seven parts, contains an alphabetical index and catalog data on power plant equipment; testing, measuring and recording apparatus; power transmission machinery; conveying, hoisting and transporting machinery; metals, alloys and other materials; machine tools and shop equipment and finally, compressing, pumping, hydraulic and industrial machinery.

The directory section is alphabetically indexed with convenient cross references and the inclusion of trade names in the index serves as an additional aid in locating particular equipment. Under each heading have been entered the names and addresses of representative firms which manufacture that particular line. Some idea of the scope of this volume may be gained when it is considered that there are 3,900 classifications of equipment and 4,400 firms listed in the mechanical equipment directory section alone.

The final section is the professional service directory in which is classified the specialized lines of practice of A. S. M. E. members engaged in professional service work and the catalog pages describing the qualifications, achievements and special services offered by various individuals and organizations. In the directory are listed 575 engineers and 346 classifications. The edition as a whole, although large in size is light in weight and easily handled.

What Our Readers Think

Question on Switch Engine Service Answered

St. Joseph, Mo.

To the Editor:

Three questions as to the length of service that should be obtained from a new set of side rod bushings, a new set of tires and a set of two-inch driving box crown brasses equipped with grease cellars on an eight-wheel switch engine, working 24 hours a day, 315 days a year, were raised by "Shop Foreman" in your September issue. In the first place, if you have any switch engine or any other locomotive that will do 24-hour service 315 days in the year, you should nurse it like a baby and give it anything it needs. Counting the time out of service for daily inspections, washing the boiler, cleaning the flues, quarterly and yearly tests, one would think that all the time left, after making the necessary repairs, would be about 275 days a year.

The questions asked are ones that cannot be answered alike by all roads. But on our division a set of rod brasses, on the type of locomotive referred to, is giving one year's service. We have three of these heavy switch engines and it is seldom that the rod brasses have to be replaced between shoppings. We shop these locomotives about once a year for heavy running repairs. Much depends on the condition of the shoes and wedges. The brasses will last much longer if the shoes and wedges are kept up than if you try to keep the shoes and wedges up with the rods. True crank pins are another important factor in determining the life of rod brasses.

Tires, like any other part of the engine, depend largely on the service they must perform. First, one must have careful enginemen and second, such locomotives must work on fairly straight track. If there are many sharp curves to be traveled in a day's service with only 1-32-in. cutting per month, then you are getting a very good average, and according to federal inspection, the tires would not have to be trued or turned for a year.

Crown brasses are renewed about once every two years on our locomotives. They are put in the machine and trued up about once a year and replaced every two years.

E. C. Jackson.

Rating Personal Characteristics of Apprentices

To the Editor:

The articles on apprenticeship which have appeared in recent issues of the *Railway Mechanical Engineer* should be interesting to all mechanical officers, industrial as well as railroad. There is a great need in this country for more regular apprentice training in all the mechanical trades.

On page 531 of the September issue, is shown a personal characteristic card, which, I take it, is made out by the apprentice instructors. Just how is this marked?

Take "Honesty," for instance. How much dishonesty would one be guilty of to be poor and just how would the distinction be made between poor, medium, good, etc? I know it is possible to grade eggs in such a manner, but would it not be rather difficult with boys? In the case of "Morality," how would medium and poor morality be defined? "Temperance," I take it, refers to the amount of intoxicating liquors used. Is it not difficult to differentiate between "Initiative" and "Resource"?

Some of our apprentices who have read these articles have asked me to show them how to mark one of these cards, and I must confess my inability to do so. This request is not made in any attempt to be facetious at all, but with an honest desire to learn something that possibly the writer should already know as he has been rating boys for over 30 years.

Observer.

The following reply to Observer's inquiry from an apprentice instructor who has been using the personal characteristics card referred to will be of interest to all who are engaged in personnel work whether with apprentices or other employees.—Editor.

Topeka, Kan.

To the Editor:

The question raised by Observer relative to the personal characteristics card published in one of the articles on Apprenticeship Methods on the Santa Fe is partly answered in the same article, on page 528 of the September issue, in the description of records maintained.

These forms are filled out by apprentice school and shop instructors, each without the assistance of anyone else. The purpose of this report is to obtain the unbiased opinion of the one making it out and to insure his making an intimate and careful study of the personal characteristics of each apprentice in his charge. Knowing that he must make a written report on each boy, he naturally studies them more thoroughly and thus becomes more familiar with each boy's good and bad traits and also with the best avenues of approach to his mind and heart. He is thereby better enabled to render help where needed and in the manner in which his assistance will be most effective.

It is not expected that the reports from the different instructors will at all times agree nor even that those by the same instructor at different times will be identical. These will vary with the accuracy of the knowledge gained as to each boy's real characteristics and with the interpretation of the terms used. But even though the instructor may err in his judgment of the boy, the study of these characteristics will have been worth while.

Observer says that some of the apprentices who have been reading these articles have been trying to fill out the cards for themselves. That is fine. Would it not do all of us good occasionally to go off by ourselves and seriously check up our own honesty, morality, tact, resourcefulness, reliance, foresight, appearance, memory, energy, industry, initiative, persistence, assertiveness, promptness, accuracy, personality, loyalty, popularity with authorities and associates—whether we are making good and living up to our ideals? Even though we may err in our judgment of our own personal characteristics, the study, if honestly made, will have been worth while and we will be better enabled to bring each characteristic nearer our ideal. Just so with the instructor's study of the characteristics of his apprentices, if honestly made, it will show him not only where the boy needs assistance, but also where he as an instructor has failed and needs to make a greater effort to bring out the best that is in each boy. Personnel officers and other executives will likewise find a searching study of the characteristics of the men in their charge to be of inestimable value.

The study of these characteristics is of far more importance than the terminology of the report or the interpretation of the terms used. Some of the terms used on our card more or less overlap. Some of them may be interpreted differently, but this does not affect the value of the study nor seriously impair the value of the record.

From Observer's letter, he appears to be of the opinion that there are no degrees of honesty, that all men are either honest or dishonest. This opinion is shared by writers of

certain articles recently published in England. Those of this opinion in filling out the card in question would necessarily rate the boy's honesty as either poor or very good. But are there not different degrees of honesty and of morality just as there are different degrees of good and bad? One swallow doesn't make a summer. One good act doesn't make a saint. Neither does one bad act necessarily make a boy a "bad egg." Is a boy who would cheat in a school examination when his fellow students were permitted to do likewise necessarily as dishonest as one who realized the seriousness of his offense and persisted in his dishonest practice? Or is one who, in a moment of weakness, temptation or fear, covers up a job of spoiled work in the shop, say by bending a slightly misfitting bolt to make it appear tight, as dishonest as one who continually deceives his employer as to the quality of his work, or as one who wilfully steals and disposes of company property? Or is a boy who at some time in his life stole a watermelon as dishonest as one who robs a bank? One leading and guiding young men must take many things into consideration and endeavor to see the boy's viewpoint. One apparently dishonest act need not brand the boy as a thief.

As to the term temperance, this need not be restricted to the amount of intoxicating liquors used. The ideal apprentice should be temperate in all things.

It should not be difficult to differentiate between the words initiative and resource. A boy might be resourceful in being capable of finding some other way of accomplishing his task when ordinary methods failed, and yet have very little initiative to start anything or to go ahead for himself. The trait of initiative is rather one of leadership or originality than of resourceful ability.

But let us repeat that the terminology used is not so important as is the study of the apprentice's characteristics. The filling out of some such card at stated periods will aid in making the study more thorough and effective.

Incidentally, these reports have their value as a record. But in justice to the boy, it must be remembered that each report merely represents one man's opinion. Their greatest value as a means of judging one's real character and ability will be found when the reports from the different instructors or foremen are considered together. In passing on the fitness of apprentices the apprentice board as a whole should render judgment. The future of the boy and his value to his employer should not be blighted by the unfair prejudice or erroneous opinion of one member of the board. Every effort should be made to ascertain each boy's fitness, to place him where he belongs, to give him the experience and training needed to develop him to his greatest possibilities. A right study and record of his personal characteristics will be found a means to that end.

APPRENTICE INSTRUCTOR.

Co-operation—The Spirit of Service

LORAIN, Ohio.

TO THE EDITOR:

Like unto the fabled traveller through the Alpine village, whose cry was "Excelsior," we of the older school of railroad shop mechanics who have kept to our faith that someday, somehow, a brighter day would dawn for us, felt as if our dreams were about to be realized when first the idea of co-operation was spread amongst us. Truly we felt as if the millennium had arrived.

Some one has defined the term co-operation as the spirit of service. If two parties agree to co-operate it becomes imperative that each one bear an equal share of the burden. There must be a closer relationship established, more of the spirit of understanding between them and a readiness to concede that though one must wear the overalls it does not imply a lower moral or mental understanding. Many good shopmen have become discontented and careless in their duties because those in charge did not have brains enough to know that the adoption of an "holier than thou" attitude was the one most calculated to breed discontent and make of themselves a liability to the company rather than an asset. Human nature changes slowly, but there is always hope for the future.

Why should not this idea of co-operation spread? To the thinking worker it means, if carried out in its fullest sense, steady employment, contentment at work and the knowledge of efforts being appreciated. To most shop men, when these three items are assured, nothing more could add to their happiness. To the company it means just one thing—success. What an enviable position the president of a railroad occupies, who has back of him an army of contented and efficient employees, all working toward the one ideal—service to the public! No greater honor could come to any man. Railroad employees, as a rule, are not visionary, not idealists, and yet not over pessimistic, and to the majority this idea of co-operation should appeal as the means to that goal to which all good men aspire—contentment, both now and in the years to come.

JOSEPH SMITH.

Changing Trailing Truck Springs

LYNCHBURG, Va.

TO THE EDITOR:

I read with considerable interest the article on changing trailing truck springs which appeared on page 433 in the July issue of the *Railway Mechanical Engineer*. We have a method of changing locomotive springs which I think may also interest the readers of your magazine.

The Southern has a class of Mountain type locomotives which have the driving and trailer spring rigging connected by a cross equalizer. When it is necessary to renew a spring on one of these locomotives, it is run on a track in which there are two 36-in. pieces of removable rail. This track is located just outside of the enginehouse convenient to the spring platform. The work is performed as follows:

1—Place the locomotive on the track so that the removable pieces of rail will be between the back drivers and the trailer wheels.

2—Block the equalizers between the intermediate and the back drivers on both sides of the locomotive.

3—Remove the two pieces of rail and let the back drivers drop in the opening.

4—Block between the back driving boxes and the frame on both sides.

5—Move the back drivers ahead upon the rail and allow the trailer wheels to drop in the opening.

6—Both trailer springs may now be renewed if necessary.

7—Remove the blocking and the job is complete.

This job has been performed on the Southern at the Monroe, Va., shops in 27 min. by a machinist and a helper who assisted in lifting the spring in place. The necessity of handling heavy jacks and oak boards is done away with by this method.

W. R. McIVOR.

Who Can Answer This Question?

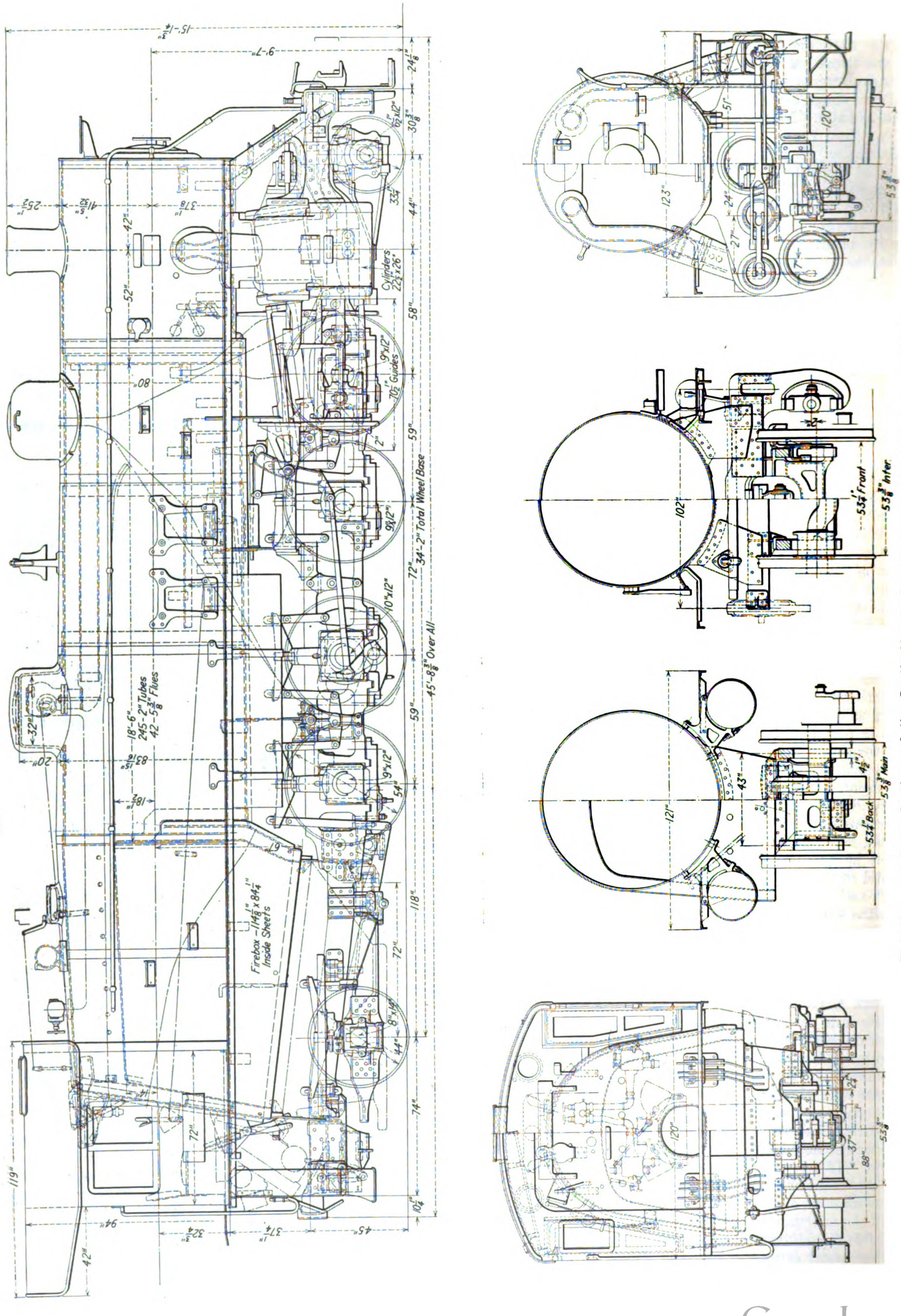
CORDOVA, Alaska.

TO THE EDITOR:

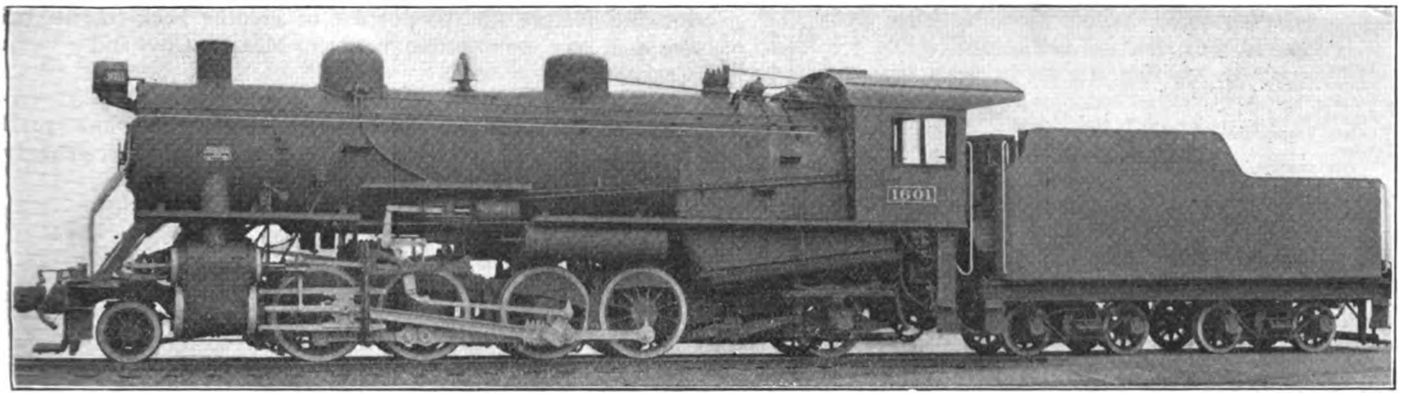
I would like some information relative to the reclamation and recutting of files. It is my understanding that some of the railroads in the United States use an acid solution in which worn files are recut, and that this reclaiming process shows a saving over the cost of new files.

Can you give me this formula and any other information regarding this subject?

JAMES SHERIDAN,
Copper River & Northwestern.



Elevation and Cross Sections of the South Manchurian Three-Cylinder Mikado Locomotive



Three-cylinder 2-8-2 type Locomotive built for the South Manchurian Railway.

Three-Cylinder Mikado for the South Manchurian

Unusual Test Methods Provide Accurate Data on the Performance of This Type of Locomotive

THE outstanding development of recent steam locomotive design has been the three-cylinder type. Early in 1923 the American Locomotive Company converted a two-cylinder 4-8-2 type locomotive into a three-cylinder type for the New York Central and later in the same year one of the same general type was built for the Lehigh Valley, both of which were primarily designed for fast freight service. The same builder has recently completed the construction of five three-cylinder Mikado type freight locomotives for service on the South Manchurian Railway. The design is unusual and, because of the fact that more comprehensive test data is available on actual performance than on previous designs, a description of this locomotive and its performance is of exceptional interest.

Description of the Locomotive

This locomotive has three simple cylinders 22½ in. in diameter by 26 in. stroke. The main rods of all three cylinders are connected to the third pair of driving wheels. The main and side rods, piston rods and crank axles, with the exception of the crank axle disks, are of chrome-vanadium steel, while the crank axle disks are of carbon-vanadium steel. The cylinders are of the piston valve type, having three 12-in. piston valves of 6-in. travel, 1⅛-in. outside lap, no clearance and 3/16-in. lead in full gear, and the distribution of the steam to the two outside cylinders is controlled by Walschaert valve gear. This, by a valve actuating mechanism similar to that used on the Lehigh Valley Mountain type locomotive, controls the movements of the valve admitting steam to the center cylinder. The driving wheels are 54 in. in diameter outside of the tires. The engine truck is of the Player type, while the Cole-Scoville design is used on the trailing truck. The rigid driving wheel base is 15 ft. 10 in. and the total engine wheel base is 34 ft. 2 in. This locomotive is designed for 1½ per cent grades and to negotiate curves of 16 deg. maximum.

The boiler is of the straight top type, designed without combustion chamber. The firebox is of the wide type, measuring 84¼ in. by 114⅛ in. The crown, side and back firebox sheets are ⅜ in. thick, and the tube sheets ½ in. thick. The firebox water spaces at the sides and back are 4½ in. and 5 in. at the front. The depth of the firebox from the center of the lowest tube to the top of the grate is 24½ in. The crown is radially stayed with 13/16-in. staybolts. Alco staybolts are used.

The boiler tubes are 2 in. in diameter, 245 in number. The flues are 42 in number and 5⅜ in. in diameter. The length of the tubes and flues is 18 ft. 6 in. over tube sheets, and the spacing in the tube sheets is ¾ in. One of this order of five locomotives has been equipped with a Superior flue blower. The Franklin grate shaker, the Franklin butterfly firedoor, the Elvin mechanical stoker and the Type A superheater with a heating surface of 945 sq. ft. are standard on the whole order. The total evaporative heating surface of the tubes, flues, firebox and arch tubes is 3,695 sq. ft., making a combined superheating and evaporative heating surface of 4,640 sq. ft. A Chambers throttle is fitted in the dome.

The Westinghouse operating brake is used on engine and tender. Air pressure is supplied by two Westinghouse 9½-in. air pumps and stored in two main reservoirs, one 22½ in. by 84 in. and the other, 22½ in. by 108 in.

The principal dimensions, weights and proportions are shown in Table I.

TABLE I—DIMENSIONS, WEIGHTS AND PROPORTIONS

Type of locomotive	3 cyl.—2-8-2
Track gage	4 ft., 8½ in.
Cylinders, diameter and stroke	22½ in. by 26 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Weights in working order:	
On drivers	194,200 lb.
On front truck	25,000 lb.
On trailing truck	48,800 lb.
Total engine	268,000 lb.
Tender	135,000 lb.
Wheel bases:	
Driving	15 ft. 10 in.
Total engine	34 ft. 2 in.
Total engine and tender	62 ft. 7¼ in.
Wheels, diameter outside tires:	
Driving	54 in.
Front truck	33¼ in.
Trailing truck	44 in.
Journals, diameter and length:	
Driving, main	10 in. by 12 in.
Driving others	9 in. by 12 in.
Front truck	6½ in. by 12 in.
Trailing truck	8 in. by 14 in.
Boiler:	
Type	straight top
Steam pressure	180 lb.
Fuel, kind	bituminous
Diameter, first ring, inside	80 in.
Firebox, length and width	114⅛ by 84¼ in.
Tubes, number and diameter	245, 2 in.
Flues, number and diameter	42, 5⅜ in.
Length over tube sheets	18 ft. 6 in.
Grate area	66.8 sq. ft.

Heating surfaces:	
Firebox	217 sq. ft.
Arch tubes	29 sq. ft.
Tubes	2,361 sq. ft.
Flues	1,038 sq. ft.
Total evaporative	3,695 sq. ft.
Superheating	945 sq. ft.
Comb. evaporative and superheating	4,640 sq. ft.
Tender:	
Water capacity	6,000 gals.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 per cent	56,000 lb.
Cylinder horsepower (Cole)	2,460
Boiler horsepower (Cole) (est.)	2,200
Speed at 1,000 ft. piston speed	37 m.p.h.
Steam required per hr	51,168
Boiler evaporative capacity per hr., lb. water	45,650
Coal required per cyl. hp., total	8,000
Coal rate per sq. ft. grate per cyl. hp	120
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	72.5
Weight on drivers ÷ tractive force	3.47
Total weight engine ÷ cylinder hp	109
Total weight engine ÷ boiler hp	121
Total weight engine ÷ comb. heat. surface	57.7
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	89.4
Comb. heat. surface ÷ cylinder hp	1.88
Tractive force ÷ comb. heat. surface	12
Tractive force × dia. drivers ÷ comb. heat. surface	651
Cylinder hp. ÷ grate area	36.8
Firebox heat. surface ÷ grate area	3.2
Firebox heat. surface, per cent of evap. heat. surface	5.9
Superheat. surface, per cent of evap. heat. surface	25.6

Tests of the Manchurian Mikado

On account of the unusual design of the three-cylinder locomotive built for the South Manchurian Railway, the American Locomotive Company was particularly interested in securing accurate tests for determining the mechanical efficiency at various speeds, cut-offs and loads.

An arrangement was made to use the test track and

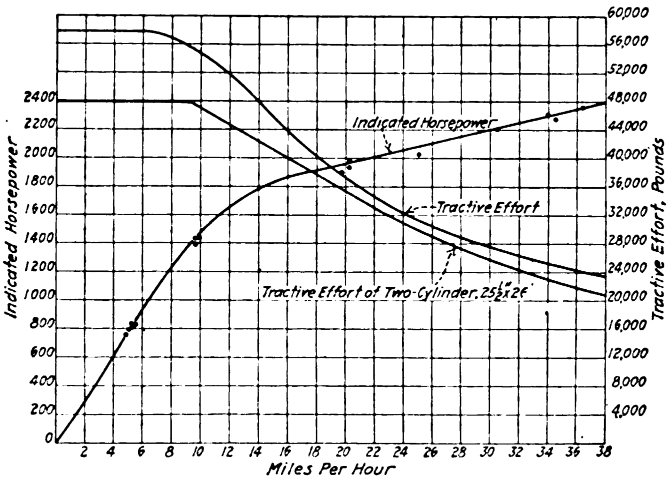


Fig. 1—Chart Showing Indicated Horsepower and Tractive Force of Three-Cylinder Mikado and Theoretical Tractive Force of Similar Two-Cylinder Locomotive

facilities of the General Electric Company at the Erie, Pa., works for these tests. The electric locomotive used was one of ten units built for the Mexican Railway Company, Ltd., which at that time happened to be ready for shipment. This locomotive was designed to operate from a 3,000-volt direct current trolley and equipped with the regenerative braking feature for the purpose of holding back trains on the four per cent grades between Mexico City and Vera Cruz.

Because of the well recognized accuracy of electrical instruments, it was possible to determine the draw bar pull being exerted by the steam locomotive much more accurately

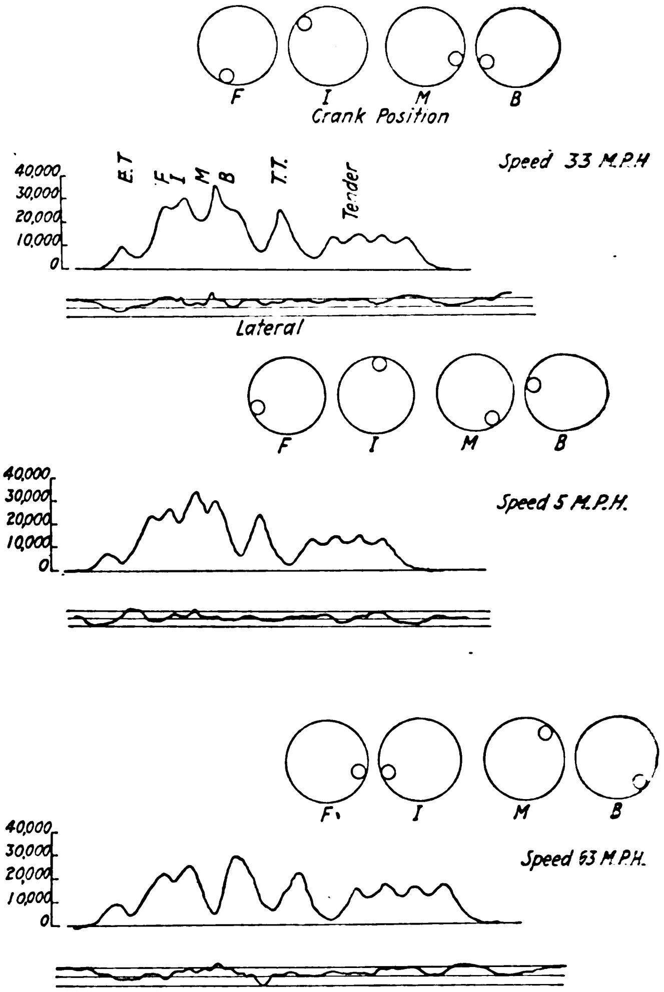


Fig. 2—Otheograph Records Showing Track Reactions

than by the use of mechanical measurements. In order to calculate the load for each run, recording and indicating instruments were used reading the total line current, speed and voltages. Speed was indicated on a tachometer in the cab and was also checked by an electrical instrument recording wheel revolutions. From the characteristic curve of the motors it was possible to calculate accurately the electrical losses in the locomotive. The friction losses of the locomotive were obtained by experimental runs. Corrections were also made for grade and curvature.

An interesting check was made on the calculations by using one electric locomotive motoring and the other regener-

TABLE II—SELECTED TEST RECORDS SHOWING DRAW BAR PULL AND MECHANICAL EFFICIENCY

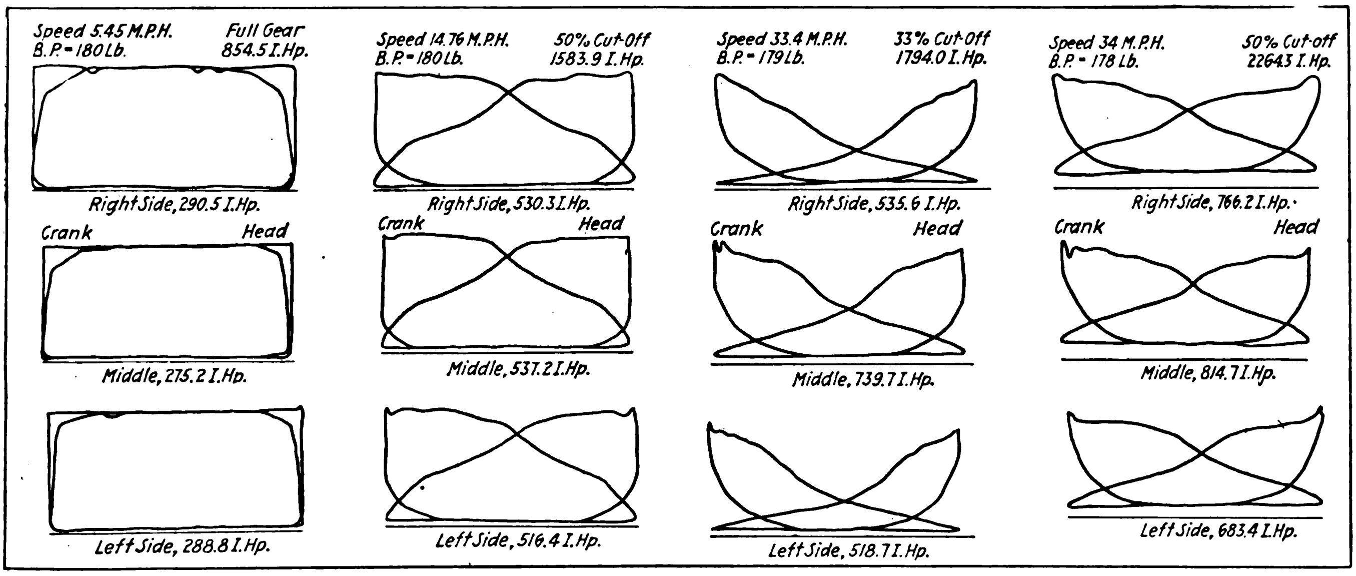
Speed, m.p.h.	Cut-off, per cent	Boiler pressure	I.hp.	Ind. tractive force	Curve and grade resistance	Draw bar pull from electric loco.	Resistance of engine and tender: Lb. at draw bar	Resistance of engine and tender: Hp.	Mech. efficiency per cent
5.45	83.1	180	854.8	58,800	1,050	47,684	10,066	146.3	82.9
10.41	79.0	180	1,540.4	55,500	.....	49,319	6,180	171.6	88.9
14.76	49.5	180	1,583.9	40,240	.....	35,219	5,020	197.6	87.5
15.07	72.8	173	1,364.5	33,950	1,220	30,135	2,595	104.5	92.3
14.75	22.8	180	898.7	22,850	.....	18,319	4,530	178.2	80.1
25.45	72.3	181	1,773.3	26,640	.....	24,319	2,320	157.5	91.3
30.50	58.5	177	2,200.0	27,050	.....	21,619	5,430	441.6	79.9
34.00	49.8	178	2,264.3	24,963	.....	17,599	7,364	689.0	70.4
34.20	45.5	179	2,177.7	23,880	1,050	17,304	5,530	504.3	76.9
33.40	22.3	180	1,408.4	15,810	1,050	11,384	7,490	667.1	78.6

ating giving in effect a pump-back test in which the substation supplied the losses. A number of runs were made at between 5 and 28 m. p. h. By means of voltmeter and ammeter readings, the total output of the locomotive when regenerating was calculated and, making allowance for known losses and compensation for friction and curve losses, the actual drawbar pull was determined.

Detailed information showing drawbar pull as obtained from the electric locomotive and the resulting mechanical efficiency of the steam locomotive is given in Table II. The test records given here have been selected from the complete data secured from a total of 65 test runs.

In Fig. 1 have been plotted curves showing the actual tractive force as well as the indicated horsepower, and the third line gives the theoretical tractive force of a similar two-cylinder locomotive having cylinders 25½ in. by 25 in. and a factor of adhesion of four which is considered a normal minimum for two-cylinder locomotives. It is apparent from the curves that the expected capacity of the locomotive was exceeded at the very low, and also at the higher speeds.

Otheograms taken at three different speeds are shown in Fig. 2. Although the locomotive was tested without the customary breaking in, there was no indication of heating at any time, even when the speed was forced up to 63 m.p.h., very good equalization of power under the circumstances, and there seems little doubt but that this locomotive is the most remarkable one of its size and general proportions the American Locomotive Company has built both as regards power and flexibility. Primarily designed for freight service, with small wheels 54 in. in diameter and long maximum cut-off, this locomotive is said to have easily attained a speed of 63. m.p.h. with only about a two-mile run to accelerate.



Characteristic Indicator Cards Taken During Tests

the equivalent of a piston speed of 1,700 ft. per min. At this speed there was no indication of rough riding in the cab and the records of the otheograph indicate remarkable lateral steadiness, or freedom from nosing, a maximum lateral thrust of 5,000 lb. being observed. The otheograms shown in Fig. 2 illustrate the track reactions at 5 and 33 m.p.h. from which it may be noted that the lateral rail thrust at 33 m.p.h. is 3,000 lb., indicating that the 5,000 lb. obtained at 63 m.p.h. corresponds to great lateral steadiness at this speed.

The rapid acceleration of this locomotive as compared with the two-cylinder type was just as much in evidence as in the previous three-cylinder locomotives built, indicator cards at full piston stroke showing admirable starting conditions.

A slight irregularity in the valve setting appeared in the indicator diagrams, specimens of which are shown in Fig. 3, due to the fact that these cards were taken with the setting just as it was turned out from the shop, there having been no opportunity to make the final adjustments before the tests. Even so the specimen cards show

Relation of Equipment Design to Maintenance*

By William H. Fowler
Erecting Foreman, Great Northern, St. Paul, Minn.

THE length of time a locomotive or car is held out of service for repairs is of vital importance and all wide awake superintendents, heads of departments and foremen are on the alert to find how the repairs may be speeded up or the designs changed so as to eliminate the necessity for so many repairs.

It appears that our old friend Co-operation—real co-operation between the various departments, engineering, purchasing and mechanical—can do much.

Often the weaknesses and defects in design, almost invariably showing up when new locomotives are first put into service, could have been eliminated had there been a real get together of mechanics and engineers in looking over the designs before they were finally submitted to the builder.

Recently, a certain railroad, on putting into service a large delivery of passenger and freight locomotives just received, found that there were no shoulders on the valve stem fits. As the engineman tightened the valve rod keys, the valves were thrown out of square so that they had to be taken out, the stem turned down and a collar bushing applied to make a shoulder to hold the valve in place on the stem—a makeshift job at best and yet it cost much in labor and time held from service. Investigation showed that the shoulder had been omitted in the blue print. On some roads the engineering or designing department seems to consider a suggestion from shop men as an interference rather than as a desire

*A paper submitted in the competition on the relation of equipment design to maintenance, which closed February 1, 1924.

to assist the company in its efforts for efficiency. Some shop foremen in Siberia during the war noted that crosshead wrist pins were applied from the outside on locomotives there. Seeing what an immense advantage this would be on heavy American locomotives, they brought the idea home with the result that their company adopted it as standard and caused the change to be made in the design of all its new locomotives. This change saves immeasurable time and labor in putting up and taking down the main rods.

Another road adopted a change which, though simple in itself, saves incalculable delay in tightening nuts on crank pin collar bolts. The change consists in having all crank pin collar bolts with nuts on the outside. When there is not sufficient room for clearance, the pin is counterbored to take the collar and the collar counterbored to take the nut. We all know how difficult it is to tighten the crank pin collar bolt nuts on many locomotives. Although a very important job, it is apt to be slighted when a locomotive must be moved in order to get at the nuts. This slight change obviates all such grief.

Another important item entering into the cost and time required for rebuilding or repairing locomotives and cars is the supply of material kept on hand. This is often inadequate, not because there were not enough supplies purchased, but because they have not been suitable for existing needs. Another place where a bit of co-operation or collaboration of the mechanical and purchasing departments might work wonders.

Often several of a class of locomotives are rebuilt and the various unused parts sent to the stores department to be held for future use. After a few months, a locomotive of this class, not yet rebuilt, is brought in for overhauling and some of the parts require renewing. A call upon the stores department discloses the fact that all these parts have been ordered scrapped. As a result, new ones must be made requiring much time and labor. Were the stores department permitted to hold this second-hand material, a great saving would result.

Another great aid in hastening repairs in shops and roundhouses would be the standardization of locomotive parts much more than is done at present. For instance, the adoption of the best and largest cylinder cock designed for use on all locomotives and of one style of injector instead of a half dozen different ones.

If all possible locomotive parts were made uniform and standard on the entire road, this practice alone would save much delay for material, keeping in service locomotives that would otherwise be waiting for parts, and also decrease the number of parts necessary to be carried in stock.

It is in the actual repairs of a locomotive or car that the errors in design show up most clearly and often the shop foreman or practical mechanic is ready to supply a remedy.

It would create greater interest in the work if his efforts and ideas were recognized by those in authority and if he were occasionally consulted by engineers, draftsmen and officers. A proved practical remedy could then be promptly applied to the defective parts without the long and tedious delays in waiting for authority, which are now necessary.

Powerful Six-Wheel Switcher for the Monon

Develops 42,000 lb. Tractive Force with 57-in. Drivers and Has a Total Weight of 191,000 lb.

THERE has been a noticeable decrease in the number of 0-6-0 type locomotives built recently for use on American railways, yet this type presents distinct advantages for handling short run switching and transfer service. It is interesting to note that some recent developments of this type have produced some unusually heavy and powerful units.

Among the heaviest yet built are three 0-6-0 switching locomotives built at the Brooks Works of the American Locomotive Company which were delivered to the Chicago, Indianapolis and Louisville, in October, 1923, and which have been reported as rendering excellent service.

The new locomotives have 23-in. by 28-in. cylinders, develop a tractive force of 42,000 lb. The weight of the engine is 191,000 lb., and of the engine and tender 356,000 lb. The tender has a capacity of 8,500 gallons of water, and 15 tons of coal. The driving wheel base is 11 ft. 6 in., total wheel base of engine and tender, 49 ft. 11¾ in., and the length of the engine and tender over all, 66 ft. 0⅜ in. The diameter of the drivers is 57 in. The boiler is of the straight top type, radial stayed, the first course is 76 in. in outside diameter and the second course 77⅜ in. in outside diameter.

Chicago, Indianapolis and Louisville Switchers Are Among the Heaviest 0-6-0 Type Built

The tubes and flues are of charcoal iron. There are 195 2-in. tubes and 32 5½-in. flues, which are 15 ft. 6 in. long over tube sheets. The pitch of the tubes is 2⅞ in. The center line of the boiler is 9 ft. 2 in. above the rail. With the firebox set back of the drivers, the depth of the throat is 22 5/16 in. from shell of boiler to bottom of mud ring.

The firebox is 73 in. long and 85 in. wide inside the mud ring. The mud ring is of cast steel 3½ in. thick, 4½ in. wide at front and 4 in. wide at sides and back. The grate area is 42.2 sq. ft.

The grates are of the box type and the ash pan of the single hopper type. The hopper frame and door are similar to the U. S. R. A. design. The frames are of cast steel and are in one piece 5 in. wide. The pedestal shoes are of bronze and Franklin wedges are used. The cylinders and valve chambers are bushed with Hunt-Spiller bushings, and this material is used for packing rings, piston heads and cross-head shoes. The tender tank is of the rectangular type with water bottom. The tender frame is of cast steel. Commonwealth trucks are used with Andrews side frames and cast steel bolsters and wheels.

The locomotives were built from designs and specifications furnished by the railway company and contain a large amount of material which is interchangeable with the railroad company's classes J-1 and K-5-A, Mikado and Pacific types, respectively.

The principal dimensions and data are shown in the following table:

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Type of locomotive	0-6-0
Service	Switching
Track gage	4 ft. 8½ in.
Cylinders, diameter and stroke	23 in. by 28 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	6 in.
Outside lap	1 in.
Exhaust clearance	0 in.
Lead in full gear	1/16 in.
Weights in working order:	
On drivers	191,000 lb.
Total engine	191,000 lb.
Tender	165,000 lb.
Wheel bases:	
Total engine	11 ft. 6 in.
Total engine and tender	49 ft. 11¾ in.
Wheels, diameter outside tires:	
Driving	57 in.
Journals, diameter and length:	
Driving, main	10 in. by 13 in.
Driving, others	9¼ in. by 13 in.
Boiler:	
Type	Straight top
Steam pressure	190 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	74 11/16 in.
Firebox, length and width	72⅛ in. by 84¼ in.
Arch tubes, number	4
Flues, number and diameter	195—2 in.
Flues, number and liameter	32—5½ in.
Length over tube sheets	15 ft. 6 in.
Grate area	42.2 sq. ft.
Heating surfaces:	
Firebox	156 sq. ft.
Arch tubes	20 sq. ft.
Tubes	1,574 sq. ft.
Flues	710 sq. ft.
Total evaporative	2,460 sq. ft.
Superheating	593 sq. ft.
Comb. evaporative and superheating	3,053 sq. ft.
Tender:	
Water capacity	8,500 gals.
Fuel capacity	15 tons
General data estimated:	
Rated tractive force, 85 per cent	42,000 lb.
Cylinder horsepower (Cole)	1,809
Steam required per hour	37,650 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	4.55
Total weight engine ÷ comb. heat. surface	62.6
Boiler proportions:	
Tractive force ÷ comb. heat. surface	13.7
Tractive force × dia. drivers ÷ comb. heat. surface	784
Firebox heat. surface ÷ grate area	4.17
Firebox heat. surface, per cent of evap. heat. surface	7.16
Superheat. surface, per cent of evap. heat. surface	24.1
Tube length ÷ inside diameter	105

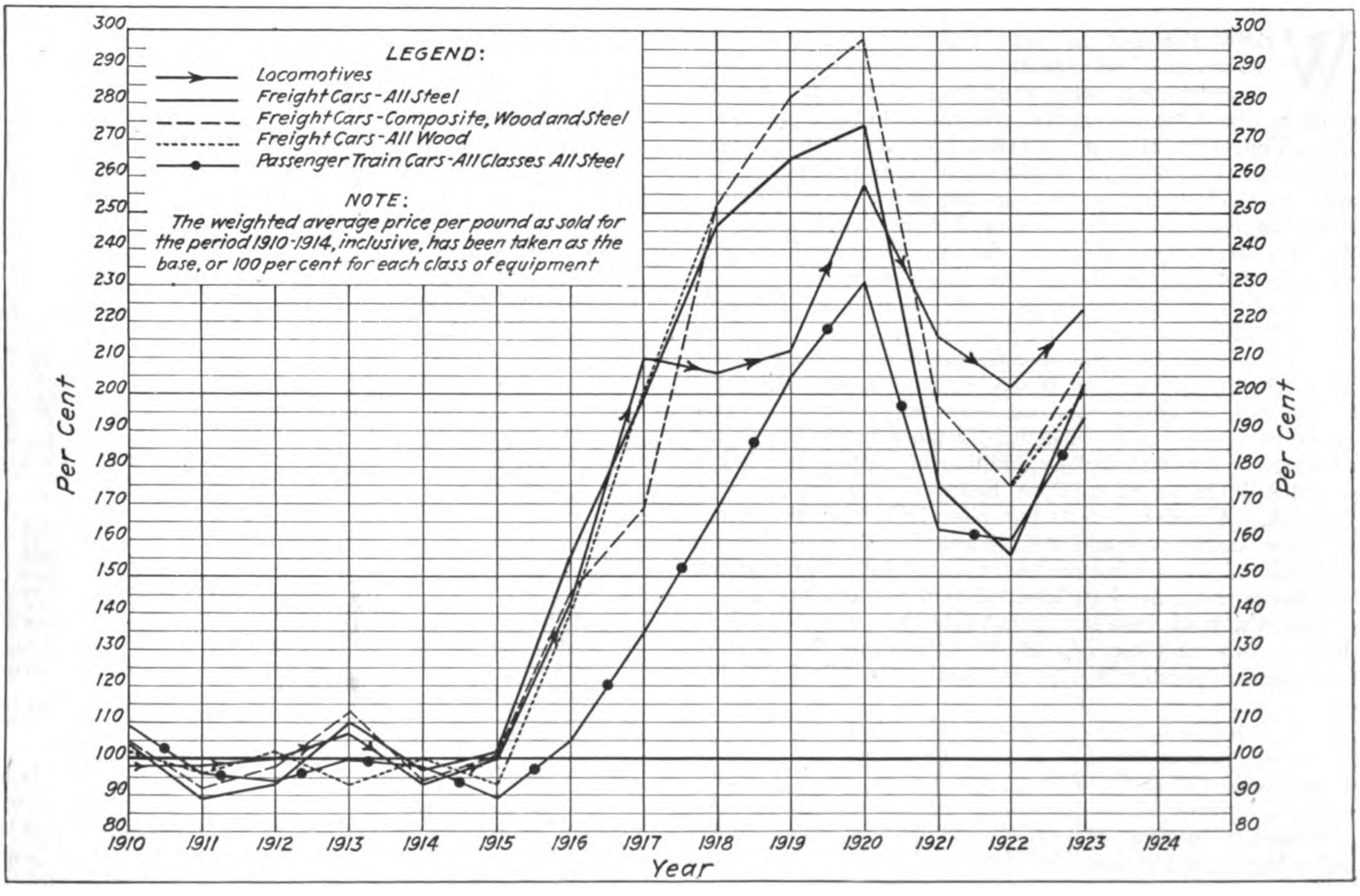
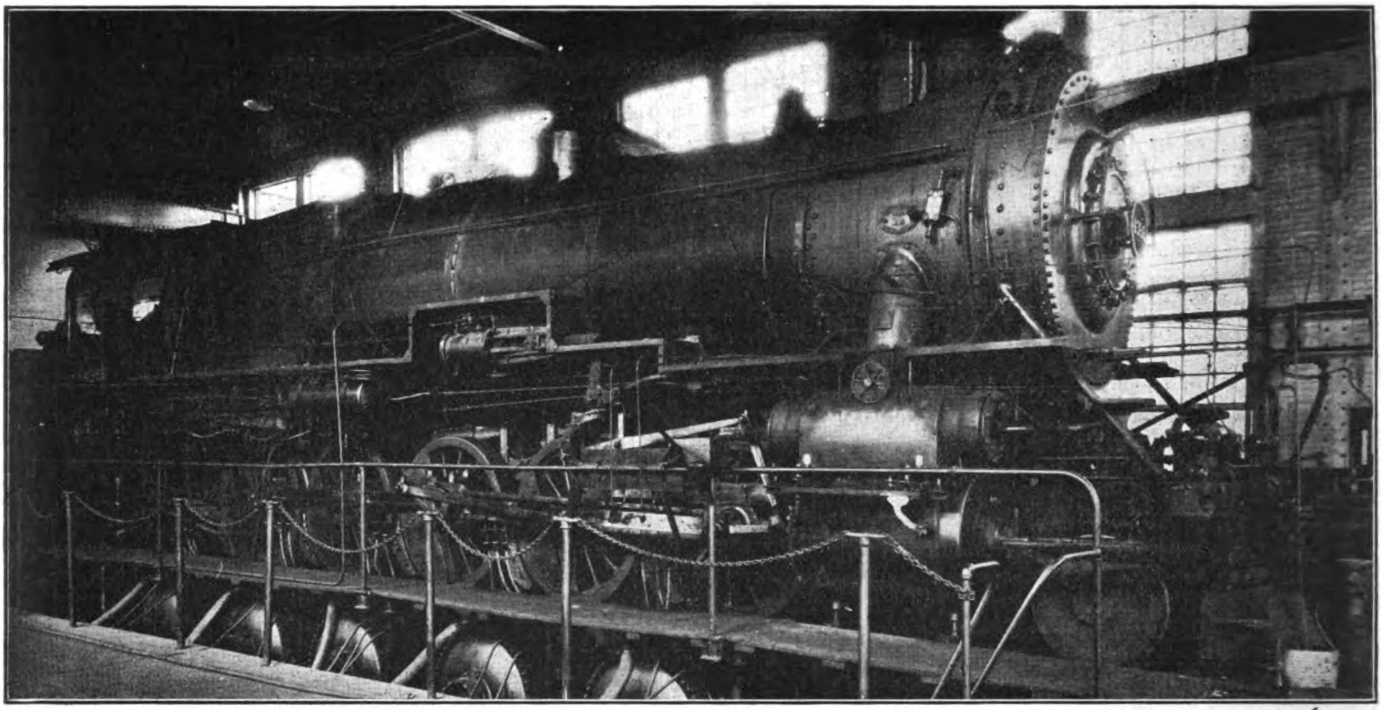


Chart Showing the Relative Prices of Cars and Locomotives from 1910 to 1923 Inclusive



Decapod Type Locomotive No. 4358 on the Testing Plant at Altoona, Pa.

Decapod Tests Show Well Defined Fuel Economy

Addition of Feedwater Heater Results in 14 Per Cent Coal Saving Over Previous I1s Pennsylvania Locomotives

When the first of the Decapod, or 2-10-0 type, locomotives was built by the Pennsylvania, exhaustive tests were conducted at the Altoona test plant to determine the relative efficiency of this type, which has cylinders working at a maximum cut-off of 50 per cent, as compared with the L1s Mikado type freight locomotive with cylinders working at long maximum cut-off. These tests, made on locomotive No. 790 were described in the *Railway Mechanical Engineer* for April, 1920, page 193. Certain alterations in design were made as a result of the test and 122 more locomotives of the same type were built and placed in service.

Since August 1922 the Pennsylvania has received from the Baldwin Locomotive Works 475 additional class I1s locomotives, making a total of 598 now in service. These latest Decapods are of substantially the same design as the previous ones except for the addition of a feedwater heater and the inclusion of a Type E superheater instead of a Type A. A series of tests has recently been made on one of these locomotives and it is interesting to note that the addition of the feedwater heater has resulted in material savings over the previous locomotives not so equipped.

The results of these test plant trials are given in detail in Bulletin No. 32 (copyright 1924 by the Pennsylvania Railroad System) from which the information in this article has been secured.

Locomotive No. 4358, selected for these tests, was built in January, 1923, and had been in service for about one month before being put on the testing plant. The principal dimensions of locomotive No. 4358, used in these tests and of No. 790 used in the tests previously described are shown in the following table together with similar dimensions of the L1s Mikado type freight locomotive used on the Pennsylvania:

General Dimensions of Locomotives of the I1s and L1s Classes

Class	I1s	I1s	L1s
Type	2–10–0	2–10–0	2–8–2
Number	4358	790	1752
Year built	1923	1918	1914
Weight in working order, lb.	386,100	371,000	320,700
Weight on drivers, lb.	352,500	341,000	240,200
Weight of engine and tender in working order, lb.	590,900	575,700	497,050
Tractive force (calculated) lb.	*90,024	*90,024	x61,465
Tractive force per lb. m. e. p.	480	480	353
Driving wheels, diameter, in.	62	62	62
Wheel base, driving, ft. and in.	22–8	22–8	17–½
Wheel base, total, ft. and in.	32–2	32–2	36–4½
Wheel base, engine and tender, ft. and in.	73–½	73–½	73–3½
Cylinders (simple) diameter and stroke, in.	30½ x 32	30½ x 32	27 x 30
Valves (piston) diameter, in.	12	12	12
Valve motion, type	Walschaert	Walschaert	Walschaert
Boiler pressure, lb. per sq. in.	250	250	205
Firebox, type	Belpaire	Belpaire	Belpaire
Grate area, sq. ft.	70	70	70
Small flues, number	114	244	236
Small flues (outside diameter) in.	2.25	2.25	2.25
Large flues (for superheater) number	200	48	40
Large flues (outside diameter) in.	3.25	5.5	5.5
Flues, length, in.	228	228	228
Heating surface, flues, sq. ft. (fireside)	4104	3667	3373
Heating surface, firebox (fireside) (including arch pipes) sq. ft.	287	287	305
Evaporative heating surface (fireside) sq. ft.	4391	3954	3678
Superheating surface (fireside) sq. ft.	2410	1460	1215
Heating surface, total (fireside) sq. ft.	6801	5414	4893
Feedwater heater (open type)	Worthington	None	None
Stoker	Duplex	Duplex	None
Ratio of weight on drivers to tractive force	3.9	3.8	3.9
Total heating surface to grate area	97.1	77.4	69.9
Flue surface to fire box surface	14.3	12.8	11.1
Superheating surface to evaporative heating surface	0.55	0.37	0.33

x Based on mean effective pressure, equal to 85 per cent boiler pressure.
* On account of limited cut-off, based on a mean effective pressure equal to 75 per cent of boiler pressure.

The boiler is of the extended wagon top type with Belpaire firebox, wide grate and a combustion chamber three feet long. The working pressure is 250 lb. per sq. in. and to provide for this high pressure the barrel plates have been made 1¼ in. thick. It is equipped with a Duplex stoker,

arranged so that the two elevators deliver their coal at alternate periods.

The boiler is fitted with the Superheater Company's Type E superheater in which there are 100 1-3/16-in., outside diameter, superheater elements, located in 200 3¼-in. boiler flues, each element making a single pass in each of two adjacent flues. There are 114, 2¼-in. flues in which there are no superheater elements. With this superheater the evaporative heating surface has been increased 11 per cent and the superheating surface 65 per cent over that of the earlier I1s boiler, which was fitted with a Type A superheater.

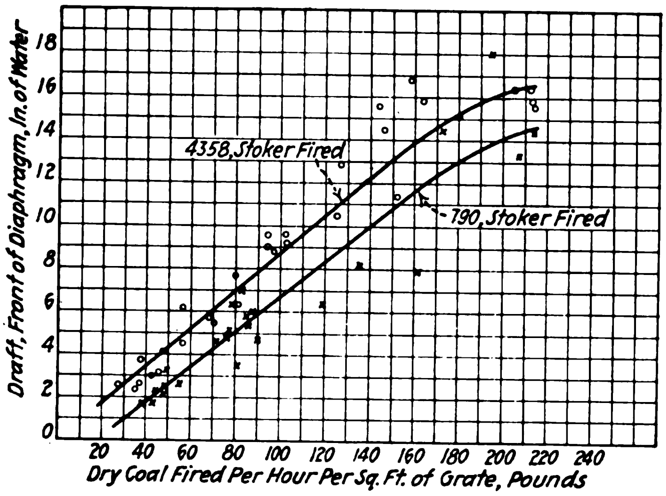


Fig. 1—Comparison of the Draft in Front of the Diaphragm, on Locomotives With and Without Feedwater Heaters

The details of the cylinders, valves and arrangement of steam and auxiliary ports are the same as in the earlier class I1s locomotive which has been described in a previous article. A new type crosshead having a single bar guide with five enclosed bearing surfaces is used on these latest Decapods.

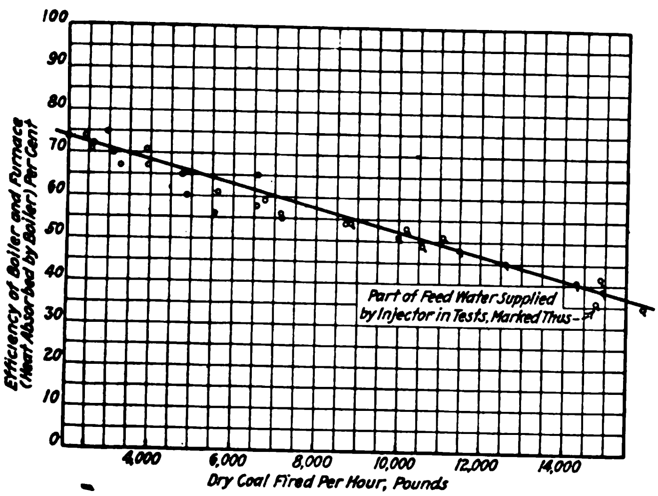


Fig. 2—Efficiency of the Boiler and Furnace

This is the first class of locomotives on the Pennsylvania Railroad on which a feedwater heater is standard equipment. The heater is of the Worthington open type, in which the feed water is heated by mixture with the exhaust steam.

Coal Used in Tests

All the tests reported here were made with coal of one kind, from a single mine. This was a high volatile bituminous coal from the Crows Nest mine. It was in run of mine size and estimated to contain from 15 to 50 per cent lumps. This is the same kind of coal as used in tests of the earlier class I1s locomotive No. 790. A representative sample from a car used in the tests when analyzed, gave the following:

Proximate Analysis of Crows Nest Coal

Fixed carbon, per cent	57.84
Volatile matter, per cent	31.12
Moisture, per cent	0.66
Ash, per cent	10.38
	100.00
Sulphur, determined separately, per cent	1.73
Calorific value, dry coal, b.t.u.	13,658

Boiler Performance

Draft, Combustion and Temperature. This locomotive has the same size nozzle as the former I1s No. 790, but the tube arrangement is different and part of the exhaust steam does not pass through the nozzle but goes to the feedwater heater. Fig. 1 shows that, in general, the draft at the front of the diaphragm was higher than in locomotive No. 790.

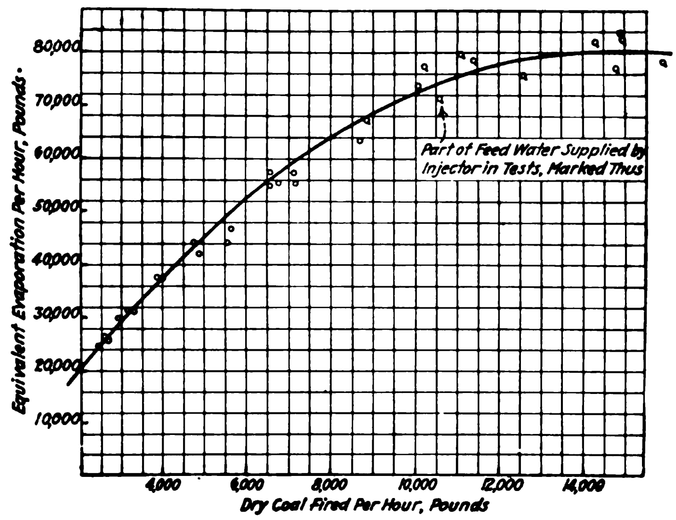


Fig. 3—Rate of Combustion and Equivalent Evaporation

The grate area of this locomotive is 70 sq. ft. Under normal conditions it is fired by a stoker, and the test results show that the maximum rate of firing was above 16,000 lb. per hr., equal to more than 200 lb. per sq. ft. of grate.

The drop in pressure between the boiler and steam chest, due to the friction of the steam passing through the Type E superheater, which has 100 units with a steam passage area of 70 sq. in., is found to be equal on the average to that through the Type A superheater, which has 48 units with an internal area of 54 sq. in.

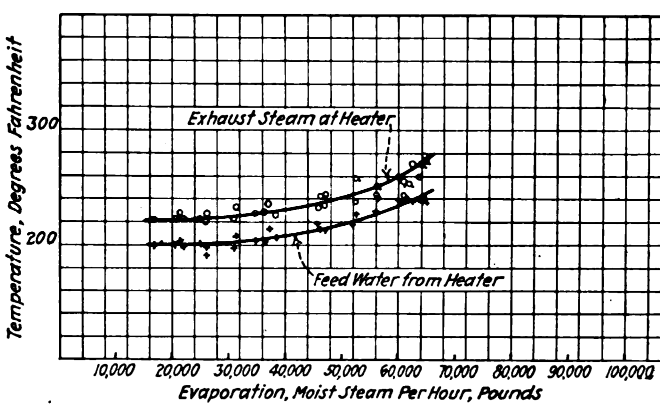


Fig. 4—Temperatures of Exhaust Steam and Feed Water from the Heater

The normal steam temperature due to the boiler pressure of 250 lb. is 406 deg. F., and in the regular tests the steam temperature ranged between 506 and 671 deg. The steam

temperature increased rapidly, with the increase in coal fired, up to a rate of about 160 lb. per sq. ft. of grate per hour, after which a greater rate of firing produced little or no increase in steam temperature. When compared with the earlier class I1s locomotive the superheat temperatures are alike for the two locomotives, when worked at the same rate of combustion.

Evaporative Capacity. When the first tests were made the locomotive had an exhaust nozzle 7⅜ in. in diameter with four projections. The net area of the nozzle was 40 sq. in., and with it the maximum equivalent evaporation was found to be 68,813 lb. In view of the evaporation of the earlier

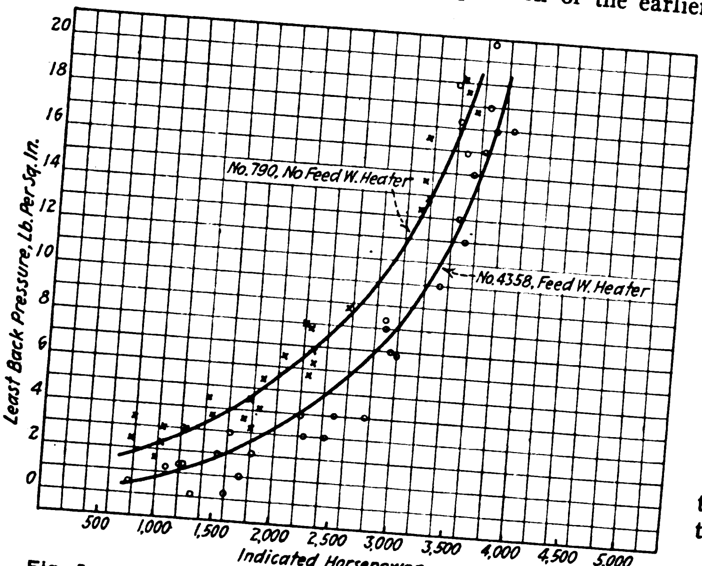


Fig. 5—Comparison of Back Pressures With and Without Feedwater Heater

locomotive of this class, No. 790, this result was thought to be low and the diameter of the exhaust nozzle was changed to 7 in. with four projections, making the net area of the nozzle 35.9 sq. in., equivalent to a 6¾ in. circle. With this 7-in. nozzle, in the only test where the boiler pressure was

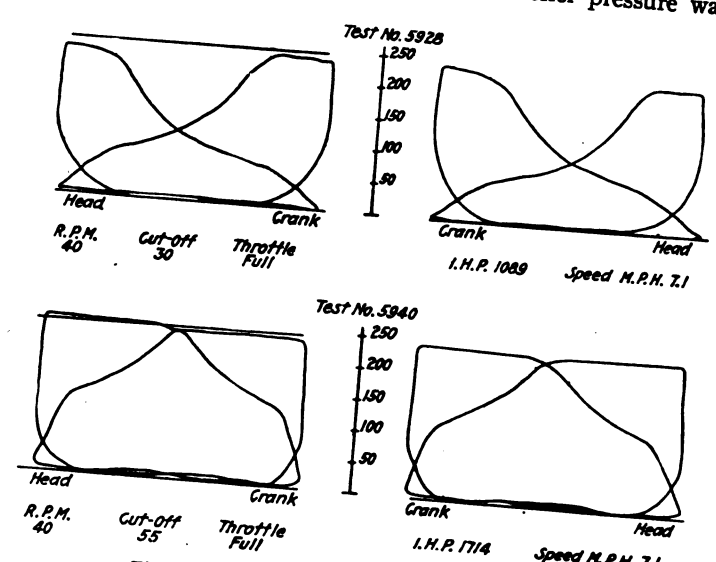


Fig. 6—Characteristic Indicator Diagrams

maintained, the maximum equivalent evaporation was 79,988 lb. per hr.

Locomotive 790 with the same size and type of exhaust nozzle and with a boiler very similar, except for a difference in the superheater and tube arrangement, shows a maximum equivalent evaporation of 82,735 lb. The maximum equivalent evaporation of locomotive 4358 was a little higher than that of locomotive 790, but, considering only the tests at which full steam pressure was maintained, the maximum evaporation of locomotive 790 was higher. The difference between all the maximum figures is only a few per cent and

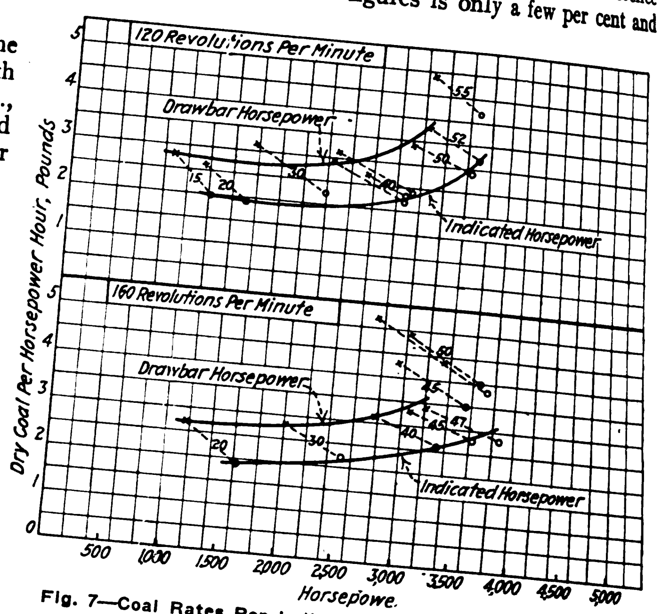


Fig. 7—Coal Rates Per Indicated and Drawbar Horsepower

the capacity of the two boilers, not including the work of the feedwater heater, is approximately the same.

Fig. 2 shows that when locomotive 4358 is stoker fired the efficiency, which is as high as 75 per cent at low rates of evaporation, decreases as the rate of combustion increases until it is only 35 per cent when firing 16,000 lb. of coal per hour. This very low efficiency occurs only when the rate of firing is beyond the reasonable capacity of the boiler. Fig. 3 shows that practically the maximum evaporation of the boiler can be secured by firing 11,070 lb. of dry coal per hour, and when more coal is fired it is largely wasted as it results in only a slight increase in evaporation. It is interesting to note that at this rate of combustion, 159 lb. of dry coal per sq. ft. of grate per hour, the maximum steam temperature was obtained. The equivalent evaporation per pound of dry coal varies from about 10.5 lb. at low rates of

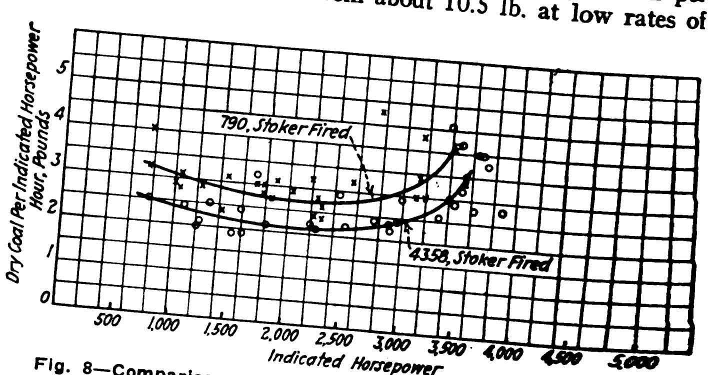


Fig. 8—Comparison of Coal Rates of Locomotives 790 and 4358, Showing Saving Effected by the Latter

evaporation, to between five and six lb. at the maximum capacity of the boiler.

The maximum figure for the equivalent evaporation per hr. per sq. ft. of heating surface reached was 12.3 lb., while the maximum figure for locomotive 790 was 15.3 lb. This difference is explained by the fact that while there is a large increase in the superheating surface of locomotive 4358 there was no corresponding increase in the maximum evaporation.

Feedwater Heater. The temperature of the water deliv-

ered by the heater depends upon the temperature of the exhaust steam, and this in general increases with the output of the locomotive. Fig. 4 shows the two temperatures at different rates of evaporation. The highest feedwater temperatures were reached when the locomotive was worked at a rate high enough to require the use of the injector to supplement the feedwater heater. During these tests the temperature and pressure of the exhaust steam were high, but the amount of water delivered by the feedwater heater was limited because part of the boiler feed water was supplied by the injector. The highest feed water temperature in any test where the injector was not used was 218 deg. F.

The direct saving, that is, the proportion of heat saved to the total output of boiler and heater, varied from 7.4 to 10.2

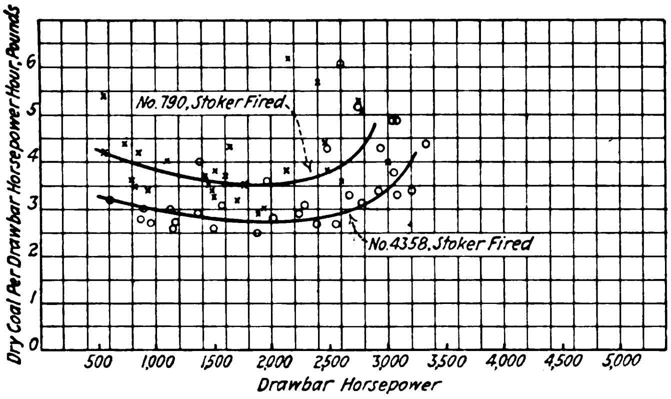


Fig. 9—Comparison of Coal Rates Per Drawbar Horsepower, Locomotives 790 and 4358

per cent in tests in which all the feed water was supplied by the heater. In road service a locomotive is seldom worked at a rate beyond the nominal capacity of the heater, but many of the tests on the plant were beyond this capacity. In these tests there is an increase in the temperature of the water delivered by the heater, but the direct saving due to the heater falls as low as 4.7 per cent because part of the boiler feed water is supplied by the injector.

The heater reduces the amount of water taken from the locomotive tender. The net saving in water by using the heater averages about 10 per cent when the locomotive is worked at rates within the capacity of the heater.

At a given rate of combustion the temperature of the steam from the superheater is not affected by the use of a heater, but as less coal is burned to develop a given indicated horsepower, the temperature of the steam is lower when the heater is used if a comparison is made at equal horsepowers.

In addition to the direct saving of the heater due to recovery of the exhaust steam from the locomotive, there is an indirect saving due to the fact that at a given horsepower the heater reduces the work of the boiler and, therefore, increases the boiler efficiency. In order to determine the total saving due to the use of the feedwater heater, eight tests with the heater, covering a range of evaporation up to its full capacity, were repeated, using the injector only to feed the boiler.

The average coal saving in the eight tests was 13.9 per cent. In the eight tests made with the feedwater heater, the average temperature of the cold feed water was 9½ deg. F. lower than in the tests without the feedwater heater. This lower temperature increased the calculated saving of the feedwater heater but decreased the coal saving, when comparison is made with similar tests with the injector in use.

The heat recovered by the feedwater heater is a direct addition to the heat output of the boiler proper and the maximum steaming capacity of the locomotive is therefore increased in the same proportion. During the tests at or near maximum boiler capacity the heat recovered by the feedwater heater varies from 4.9 to 6.4 per cent of the heat output of the boiler proper, thereby increasing the maximum steaming capacity of the locomotive in the same proportion, an average of 6 per cent. The maximum heat output of the boiler and feedwater heater of locomotive 4358 was 85,580,584 b.t.u. per hr., an increase of 6.3 per cent over the maximum heat output of locomotive 790.

Engine Performance

The engines of this locomotive are of the limited cut-off type, and with the exception of the crossheads and piston rods, differ in no way from those of the former class I1s locomotive No. 790. The water rate which is 20.8 lb. at 40 r.p.m. and 20 per cent cut-off, has fallen to 15 lb. at 160 r.p.m. and 30 per cent cut-off. At all speeds above 60 and below 180 r.p.m. the water rate lies between 17½ and 15 lb., except in a test at 120 r.p.m. and 55 per cent cut-off, where the steam pressure was not maintained because the maximum capacity of the boiler had been reached. This is a decided improvement over the performance of the L1s locomotive, where in 29 tests the water rate of only one was below 17½ lb. The lowest water rate of the I1s is obtained when the locomotive is developing between 2,100 and 2,500 i.hp. at all speeds except 40 r.p.m., where the maximum horsepower was less than 2,100.

The feedwater heater reduced the temperature of the steam at a given horsepower and should adversely affect the water rate. On the other hand, the feedwater heater, by reducing the amount of steam going through the nozzle, reduces the back pressure and, therefore, decreases the water rate. Fig. 5 shows that the least back pressure of an I1s locomotive equipped with a feedwater heater is considerably lower than that of locomotive 790 without a feedwater heater, both locomotives being equipped with the same size nozzle. These two factors offset each other and the water rate of the two locomotives is found to be in practical agreement.

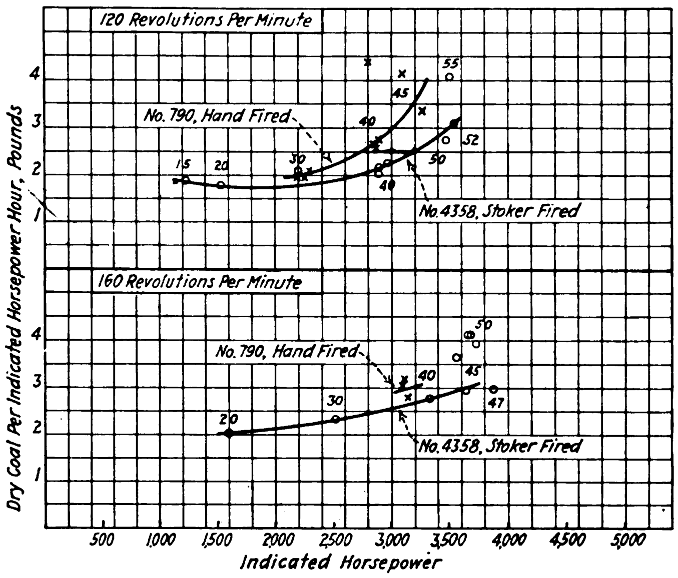


Fig. 10—Comparison of Coal Rates, Locomotive No. 790, Hand Fired with No. 4358, Stoker Fired

Characteristic indicator diagrams are shown in Fig. 6 which are of particular interest in observing that the action of the auxiliary starting ports at full gear does not materially affect the point of cut-off. The action of these auxiliary ports was described at length in a previous article.

Locomotive Performance

The performance of the locomotive as a whole is gaged by the coal burned and drawbar horsepower developed, but comparisons are also made on the basis of indicated horse-

power. All the coal and water used in the tests is charged against drawbar horsepower, but the amount chargeable to auxiliaries is not included in that charged against indicated horsepower.

At 40 r.p.m. (7.1 m.p.h.) the coal burned per i.hp. is nearly a uniform amount of 2½ lb. at all cut-offs except 55 per cent, and the coal per drawbar horsepower about 3 lb. At speeds of 40 and 80 r.p.m. (7.1 and 14.2 m.p.h.) the coal rate is shown to increase abruptly at cut-offs beyond 50 per cent. At speeds above 40 r.p.m. the coal rate per i.hp. hour is close to 2 lb. at all rates of working up to 2,500 i.hp. Per drawbar horsepower, it is less than 3 lb. Two tests show a coal rate as low as 1.9 lb. per i.hp. hour, and approximately 2½ lb. per drawbar horsepower hour. Fig. 7 shows the coal rates per i.hp. hour at speeds of 120 and 160 r.p.m.

The coal per indicated and drawbar horsepower has been plotted in Figs. 8 and 9 to compare the performance of locomotive 4358 with that of 790 when both were stoker fired. The average improvement of locomotive 4358, equipped with a heater, is found to be more than 14 per cent, which is the total saving that can be credited to the feedwater heater. As there is no difference between the engines of the two locomotives, the additional fuel saving is that due to the better boiler efficiency.

In Fig. 10 the coal burned per i.hp. hour, is shown comparing locomotive 4358, stoker fired, with 790, hand fired, at different speeds. The reason for making this comparison is that a full set of tests was made for locomotive 790 only hand fired and locomotive 4358 only stoker fired. It has not been possible to obtain as good economy with stoker firing as with hand firing and the charts are of interest in showing that, whatever economy has been lost by the introduction of the stoker, has been regained by the use of the feedwater heater.

The maximum indicated horsepower of locomotive 4358

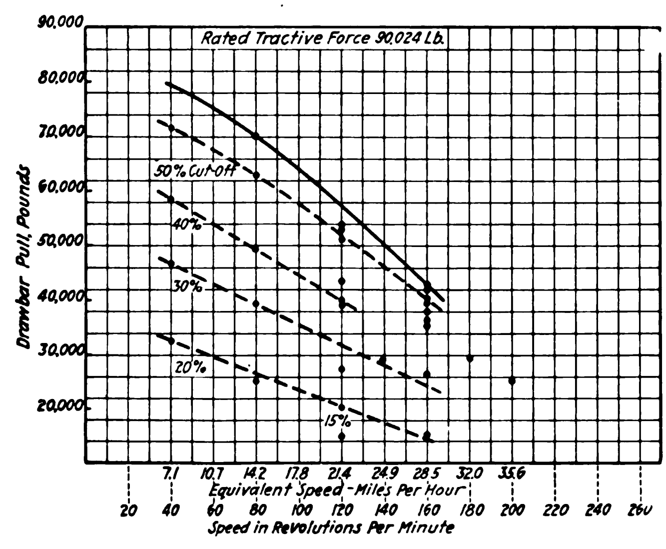


Fig. 11—Drawbar Pull at Different Percentages of Cut-Off and Various Speeds

was 3,863 and was developed at a speed of 160 r.p.m. and 47 per cent cut-off. By dividing the weight of the locomotive in working order, by this horsepower, it is found to weigh 100 lb. per horsepower. The class L1s locomotive weighs 113 lb. per horsepower at maximum rate.

While the average gain in efficiency of locomotive 4358 compared with locomotive 790 is quite large, the maximum increase in horsepower is only 9 per cent. Part of this increase is due to the lower water rate of locomotive 4358 in the particular tests under comparison. An increase in horsepower of 6.4 per cent is due to the increase in steaming capacity resulting from the heat saved by the feedwater heater. When the locomotive is operated at the maximum horsepower the injector is used to supply a large part of the feedwater and, therefore, the increase in power is less than 14 per cent, which is the percentage of saving due to the use of the feedwater heater only when the heater supplies all the feedwater.

In Fig. 11 are plotted some maximum drawbar pulls at different speeds. The amount of steam furnished by the boiler at speeds below about 15 m.p.h., is not the limiting factor in establishing the maximum drawbar pull, as then only a moderate weight of steam is required. The drawbar

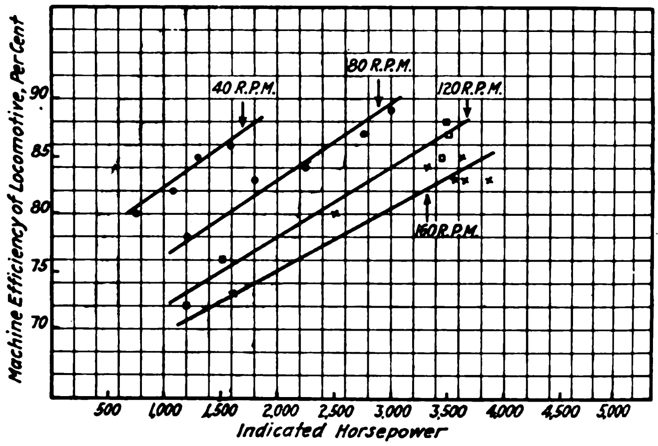


Fig. 12—Machine Efficiency Compared with Speed and Power Developed

pull at these speeds depends upon the dimensions of cylinders and driving wheels for any given boiler pressure.

Machine Efficiency—The machine efficiency of locomotive 4358 has a wide range, from 71 to 88 per cent. Over a long series of tests the variation in machine efficiency during duplicate tests is so wide that it is evident that the dynamometer readings are not always correct. In Fig. 12 is plotted the machine efficiency for all tests. The points in Fig. 12 are consistent, and while they may be too high or too low, they show that the machine efficiency follows a regular law decreasing with the speed and, at any given speed, increasing as the power developed is increased.

Conclusions

In the conclusion of the report on these tests it is stated that "the substitution of the Type E for the Type A superheater with the resultant large increase in heating surface has not noticeably increased the evaporative capacity or efficiency of the boiler; the addition of a feedwater heater has resulted in a coal saving of about 14 per cent. The performance of the engines of this locomotive confirms the results of the tests of the earlier class L1s and show the expected economy when compared with long cut-off engines."

The Unaflow Locomotive—A Correction

The September 1924 issue of the *Railway Mechanical Engineer* contained an article by Prof. J. Stumpf describing the unaflow locomotive. Fig. 1 in this article was referred to in the caption as being a theoretical indicator card. The author, however, has kindly brought to our attention that this card is not a theoretical card but is an analysis of an actual indicator card which was taken in tests on the locomotive.

Bored Pins and Axles for Locomotives

Increased Strength with Less Weight Can Be Obtained by Using Larger Inside Diameters

By Lawford H. Fry

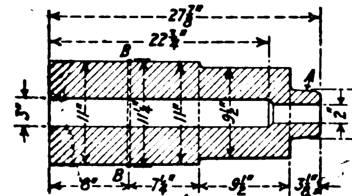
A POINT in locomotive design which has not been given the attention that it deserves is the use of sufficiently large holes in bored axles and crank pins. It is common practice to use an 11-in. axle bored with a 3-in. hole. Such an axle has a section modulus of 130.4 in.^{3} and a weight of 24.9 lb. per inch of length. Reference to the accompanying tables shows that if the axle is made 11¼ in. in diameter with a 5-in. hole, the section modulus will be 131.8 in.^{3} while the weight is reduced to 22.6 lb. per linear inch. This reduction of 2.3 lb. per inch represents a nine per cent reduction in weight and, in an axle 69 in. long, amounts to a saving of practically 160 lb. In the case of crank pins a proportionate saving can be made by the use of ample sized boring. The actual saving is not so great owing to the shorter length of the pin, but it must be remembered that every pound of weight saved in the revolving parts enables the same saving to be made in the counterbalance, so that a saving of 100 lb. in crank pin weight means a saving of 200 lb. in the locomotive weight.

A Large Bore Has Desirable Features

The use of a large bore, besides being of mechanical advantage in reducing weight, is desirable from a metallurgical standpoint. All locomotive forgings should receive a heat treatment of some sort after being forged and before being placed in service. This heat treatment may be annealing, that is a heating followed by slow cooling; or normalizing, which is a heating followed by cooling in the air; or it may be by quenching and tempering, in which the forging is heated and quenched in oil or water and then reheated to a lower temperature. Whichever treatment is given, the physical properties of the steel will be affected by the thickness of the metal to be influenced and by the amount of surface through which the heating and cooling effects can penetrate the metal. The thinner the wall thickness and the greater the surface, the more effective is the heat treatment and the better the physical properties of the steel. The following table compares the section modulus, weight, wall thickness and surface per pound of metal for three axles, having respectively, no hole, a three-inch hole and a five-inch hole. The length is taken as 69 inches and the outside diameter is assumed to be uniform at 11 inches for the first two and 11¼ inches for the third.

Outside diam., inches	Bore, inches	Section modulus, inches^3	Total weight, pounds	Wall thickness, inches	Total surface, sq. in.	Surface per lb. of steel, sq. in.	Proportionate increase in surface
11	Solid	130.6	1,860	11	2,570	1.4	..
11	3	130.4	1,720	4	3,200	1.9	35
11-¼	5	131.8	1,550	3-⅛	3,460	2.2	57

It is evidently more intelligent both mechanically and metallurgically to use an ample bore in the axle.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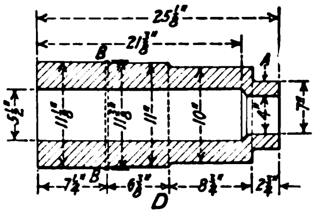
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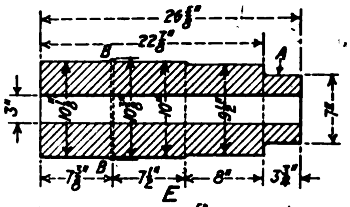
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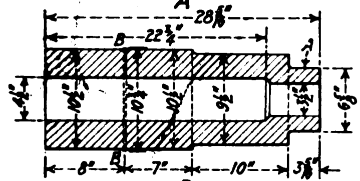
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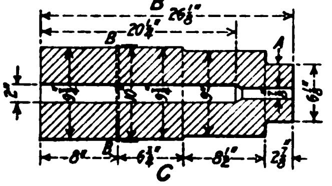
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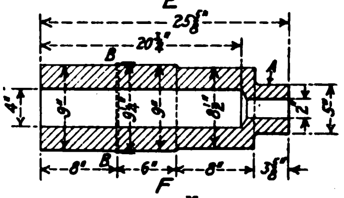
Pin	A	B	C	D	E	F	G
Material	Carbon Annealed	Carbon Annealed	Carbon Q. & T.	Carbon Q. & T.	Carbon Vanadium	Chrome Vanadium	Chrome Vanadium
Min. Tensile Strength of Material Lb./sq. in.	80,000	80,000	85,000	85,000	90,000	115,000	115,000
Cylinder Diameter	29¾"	31"	29¾"	30½"	29½"	30"	30"
Cylinder Stroke	32"	32"	32"	32"	30"	32"	32"
Boiler Pressure, Lb. per sq. in.	230	200	200	250	200	200	200
Driving Wheel Diameter	64"	63"	63½"	62"	63"	60"	60"
Weight of Pin, Lb. (Omitting Small End "A")	554	460	445	420	450	306	315
Area of Piston, Sq. ins.	695	755	695	731	683	707	707
Piston Thrust (Area x Boiler Pressure)	159,850	151,000	139,000	182,750	136,600	141,400	141,400
Lever Arm, Inches	12"	12"	11"	10¾"	11½"	10"	10"
Moment (Piston Thrust x Lever Arm) in Lb.	1,918,000	1,812,000	1,529,000	1,965,000	1,571,000	1,414,000	1,414,000
Section Modulus at "B-B"	129.5	109.6	90.7	126.9	101.2	68.7	74.9
Max. Fiber Stress at "B-B" ($\frac{\text{Moment}}{\text{Modulus}}$)	14,800	16,550	16,700	15,500	15,500	20,600	18,900
Pin Bearing Pressure, Lb. per sq. in.	1,770	1,590	1,815	2,090	1,795	2,080	2,080
Piston Thrust Per Pound of Pin, Lb.	290	330	310	435	300	460	450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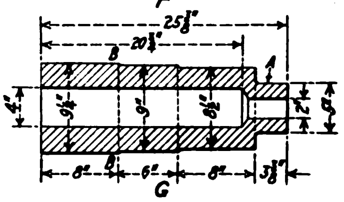
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The Results of Tests on Main Crank Pins of Various Proportions and Materials

An Analysis of Seven Main Crank Pins

An analysis of seven main crank pins of the type used on heavy modern locomotives is shown in the drawing which illustrates the effect of design and material. The outside diameters range from 9¼ in. to 11 in., the bores from 2 in. to 5½ in., and the piston thrust at full boiler pressure from 136,600 lb. to 182,750 lb. The materials represented are annealed carbon steel, quenched and tempered carbon steel, normalized carbon-vanadium steel, and quenched and tempered chrome-vanadium steel. It will be seen that the pins are designed for maximum fibre stresses of 15,000 lbs. to 16,000 lbs. per sq. in. for the carbon steel and the carbon-vanadium steels, irrespective of treatment, while for the chrome-vanadium steel fibre stresses of 18,900 lb. and 20,600

Pin	A	B	C	D	E	F	G
Outside diameter, inches..	11	10½	9¼	11	10	9	9
Bore diameter, inches.....	3	4½	2	5½	3	4	4
Piston thrust per lb. of pin weight	290	330	310	435	300	460	450

lb. per sq. in. are allowed. The last line, which shows the pounds of piston thrust carried per pound of metal, is a measure of the efficiency of the design. The figures for bore, diameter and pounds of piston thrust carried per pound of pin weight are repeated in the following table for convenience of reference.

Pins *A*, *C* and *E* with 2 in. and 3 in. bores carry from 290 lb. to 310 lb. of piston thrust for each pound of pin weight. Pin *B* with a 4½ in. bore carries 330 lb., while pin *D* with a 5½ in. bore carries over 40 per cent more with 435 lb. of piston thrust per pound of pin. These five pins are all straight carbon or carbon-vanadium with a maximum fibre stress of about 16,000 lb. per sq. in. The remaining two pins *F* and *G*, which are of quenched and tempered chrome-vanadium steel with an allowable maximum fibre stress of 20,600 lb. and 18,900 lb. per sq. in., carry respectively 460 lb. and 450 lb. of piston thrust per pound of pin. It is to be expected that the chrome-vanadium steel pins with their high tensile strength and consequently high allowable fibre stresses should show the highest load carried per pound of pin weight. At the same time it should be noted that the bore with a diameter of 4 in. stands in a satisfactory relation to the outside diameter which is 9 in. Of the other pins *A*, *C* and *E* are seen to be unnecessarily heavy for the loads they carry. The bores could be made 5 in. instead of 2 in. and 3 in. which would give a saving of about 100 lb. weight for each pin without increasing the fibre stress beyond a safe figure. Pin B with a 4½ in. bore and a diameter of 10½ in. is well proportioned and carries 330 lb. per pound of pin weight. Pin D with a 5½ in. bore stands out above the others with the high figure of 435 lb. of piston thrust per pound of pin weight. This figure approaches those of the highly stressed chrome-vanadium pins, but is obtained with a fibre stress of only 15,500 lb. per square inch. This excellent result can be traced to two causes: first, to the shortness of the pin which gives a lever arm of only 10¾ in. as compared with 12 in. for pin *B;* and second, to the large diameters chosen for the pin body and bore. The second is the more important factor. It is interesting to compare the four pins *B*, *C*, *D* and *E* for modulus and weights, as in the following table.

Pin	B	C	D	E
Outside diameter, in.	10½	9¼	11	10
Bore diameter, in.	4½	2	5½	3
Section modulus, in. cu.^{3}	110	91	122	98
Weight per in. of length, lb.	20.1	24.8	20.1	20.2

In pins *B*, *D* and *E* the weight per inch of length is practically the same for all three sections, but compared with pin *E* the better distribution of metal makes the section modulus 10 per cent greater in *B* and 22 per cent greater in *D*. On the other hand pin *C*, because of the small diameter of the body and bore, has nearly 25 per cent greater weight and at the same time about seven per cent lower modulus than even pin *E*.

Recommended Proportions

It is obvious that the greatest strength with the least weight is obtained by using a large diameter for the body and the maximum practical diameter for the bore. In working in this direction it will be found that a limit is set for the outside diameter by the increase in weight of the surrounding parts, such as rod ends and wrist pin hubs for pins, and journal boxes and axle hubs for axles.

The following proportions between the bore and outside diameter are recommended for pins and axles:

Outside diameter, inches	Diameter of bore, inches
7 to 8	3½
8 to 9	4
9 to 10	4½
10 to 11	5
11 to 12	5½
12 to 13	6

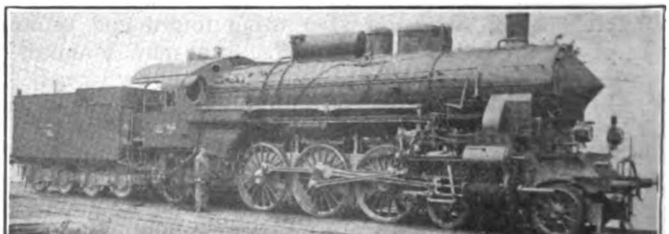
To facilitate study and design Tables I and II are presented. These tables show respectively the values for the section modulus and weight per linear inch for various combinations of outside diameter and bore. In Table I the recommended combinations of bore and body diameter are enclosed in brackets. It will be seen that these combinations provide for a gradual increase in section modulus from 31 in.^{3} to 206 in.^{3}, with the corresponding weights per linear inch increasing from 8 lb. to 31 lb.

Table I

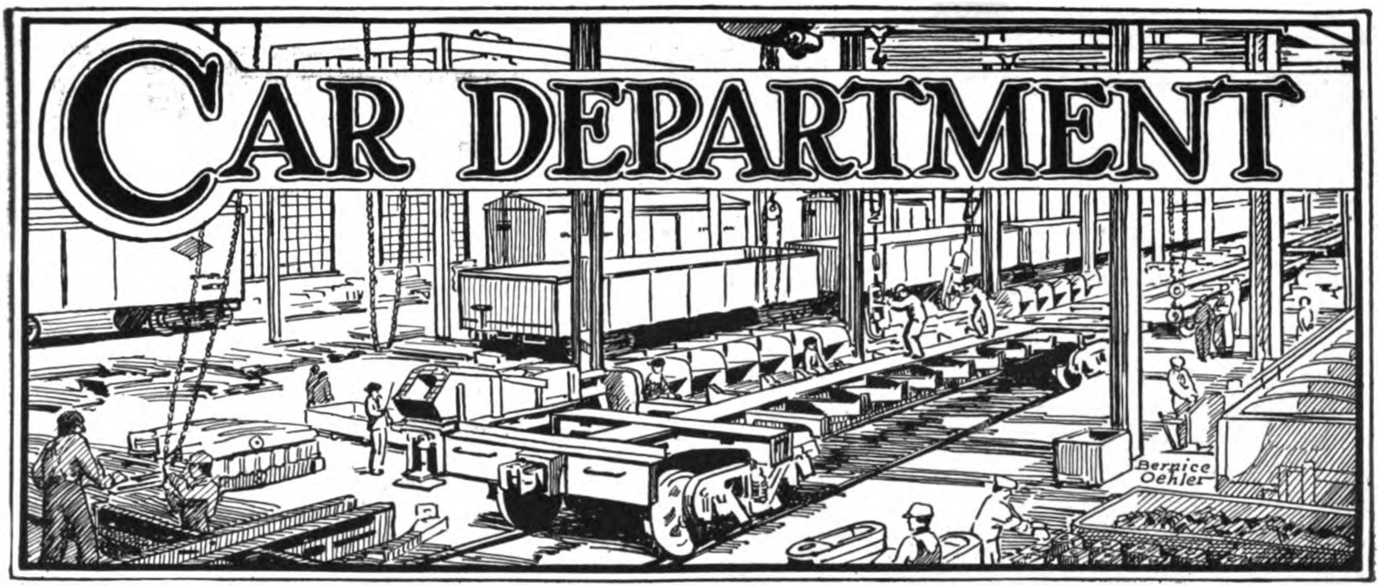
Outside diameter, in.	Section modulus Diameter of bore							
	Solid	3 in.	3½ in.	4 in.	4½ in.	5 in.	5½ in.	6 in.
7	33.7	33.3	[31.6]	30.1	....	....	....	....
¼	37.5	37.1	[35.4]	34.0	....	....	....	....
½	41.5	41.1	[39.5]	38.2	....	....	....	....
¾	45.7	45.3	[43.8]	42.5	....	....	....	....
8	50.1	49.8	[48.3]	[47.0]	45.1	....	....	....
¼	55.1	....	53.3	[52.1]	50.2	....	....	....
½	59.3	....	57.6	[56.3]	54.5	....	....	....
¾	65.8	....	64.1	[62.9]	61.2	....	....	....
9	71.7	....	70.1	[68.9]	[67.2]	62.0	....	....
¼	77.7	....	....	75.0	[73.3]	71.0	....	....
½	84.1	....	....	81.4	[79.8]	77.6	....	....
¾	91.0	....	....	88.4	[86.9]	84.6	....	....
10	98.2	....	....	95.7	[94.2]	[92.0]	89.2	....
¼	105.8	....	....	....	101.8	[99.7]	97.0	....
½	113.5	....	....	....	109.7	[107.5]	104.9	....
¾	122.0	....	....	....	118.2	[116.2]	113.6	....
11	130.6	....	....	....	126.9	[124.9]	[122.4]	119.1
¼	139.8	....	....	....	....	134.3	[131.8]	128.5
½	149.0	....	....	....	....	144.6	[141.2]	138.0
¾	159.3	....	....	....	....	154.0	[151.6]	148.5
12	169.7	....	....	....	....	162.2	[159.1]	[155.1]
¼	180.5	....	....	....	....	....	173.1	[170.1]
½	191.8	....	....	....	....	....	184.6	[181.6]
¾	203.5	....	....	....	....	....	196.4	[193.5]
13	215.7	....	....	....	....	....	208.8	[205.9]

Table II

Outside diameter, in.	Weight in lb. per linear inch Diameter of bore							
	Solid	3 in.	3½ in.	4 in.	4½ in.	5 in.	5½ in.	6 in.
7	10.9	8.9	8.2	7.3	....	....	....	....
¼	11.6	9.6	8.9	8.0	....	....	....	....
½	12.5	10.5	9.8	8.9	....	....	....	....
¾	13.3	11.3	10.6	9.7	....	....	....	....
8	14.2	12.2	11.5	10.6	9.7	....	....	....
¼	15.1	....	12.4	11.5	10.6	....	....	....
½	16.1	....	13.4	12.5	11.6	....	....	....
¾	17.0	....	14.3	13.4	12.5	....	....	....
9	18.0	....	15.3	14.4	13.5	12.5	....	....
¼	19.0	....	....	15.4	14.5	13.5	....	....
½	20.1	....	....	16.5	15.6	14.6	....	....
¾	21.1	....	....	17.5	16.6	15.6	....	....
10	22.2	....	....	18.6	17.7	16.7	15.4	....
¼	23.3	....	....	....	18.8	17.8	16.5	....
½	24.6	....	....	....	20.1	19.1	17.8	....
¾	25.7	....	....	....	21.2	20.2	18.9	....
11	26.9	....	....	....	22.4	21.4	20.1	18.8
¼	28.1	....	....	....	....	22.6	21.3	20.0
½	29.4	....	....	....	....	23.9	22.6	21.3
¾	30.6	....	....	....	....	25.1	23.8	22.5
12	32.0	....	....	....	....	26.5	25.2	23.9
¼	33.3	....	....	....	....	....	26.5	25.2
½	34.5	....	....	....	....	....	27.7	26.4
¾	36.0	....	....	....	....	....	29.2	27.9
13	37.5	....	....	....	....	....	30.7	29.4



Pacific Type, 4-cylinder Compound Express Locomotive Used on the Hungarian State Railway



Chicago & Alton Re-equips Limited Train

Non-Reversible Seats in the Coaches; Unusual Arrangement of the Observation-Parlor Cars

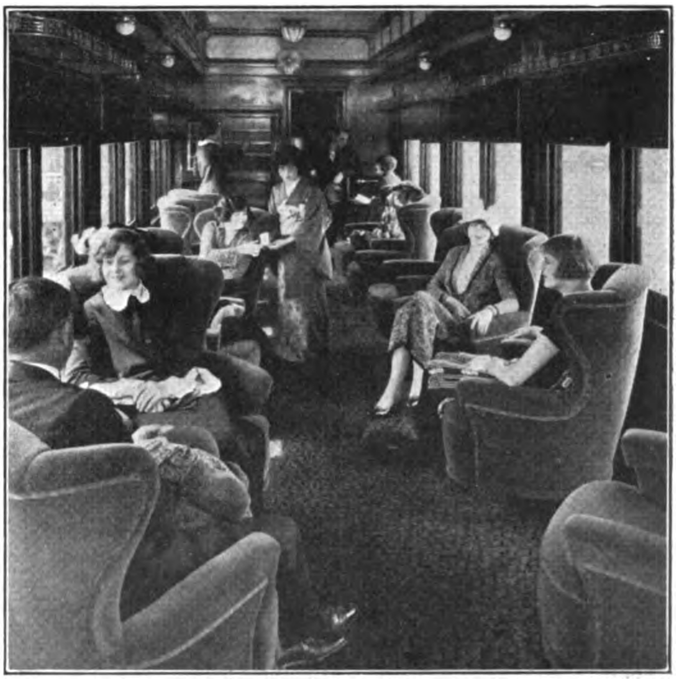
THE Chicago & Alton has re-equipped its Alton Limited running between Chicago and St. Louis, Mo. The service now consists of two new trains of all steel equipment which were recently received from the Pullman Car & Manufacturing Company, Chicago. They represent an investment of approximately one million dollars and are completely modern in safety devices, lighting, ventilating and heating equipment. All of the cars are fitted with vapor car heating equipment and thermostatic temperature control.

Interior View of the Dining Car, Showing the Buffet and Lower Deck Lights

The passenger coaches are unusually long. The coaches, dining cars and parlor cars are 87 ft. in length; the observation-parlor cars are 90 ft. long.

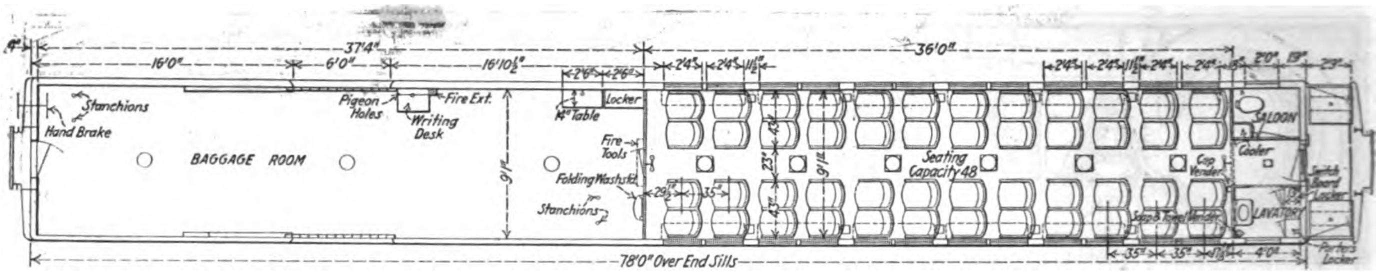
Each of the two trains has a mail storage car, one of which is named for Rudolph Brauer, superintendent of the sixth division, Railway Mail Service and the other for Captain West, chief clerk at large, Railway Mail Service. The railway post office cars are named for Paul Henderson, second assistant postmaster general and for Col. G. B. Armstrong, who is known as the father of the railway mail service.

The combination passenger and baggage cars are named for the states of Illinois and Missouri. The length of these cars over the end sills and over the buffers is 78 ft. and 86

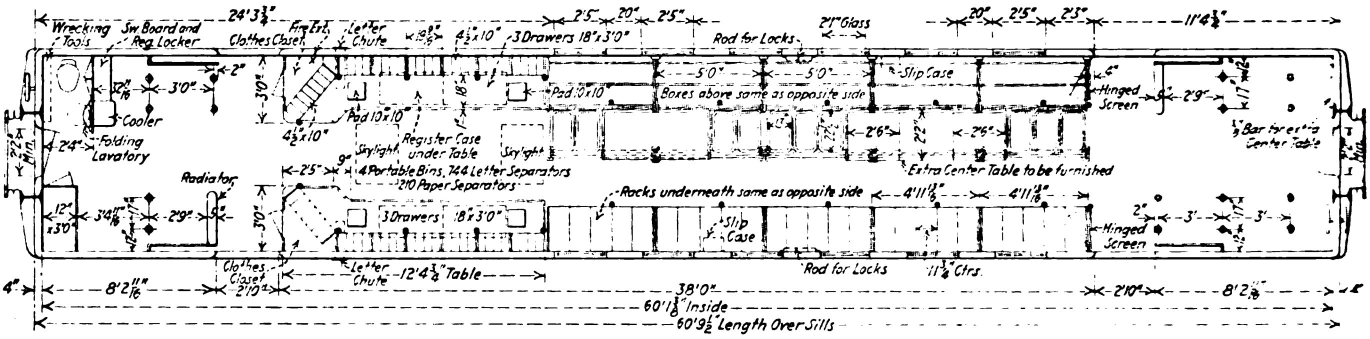


The Observation Parlor Car Has Japanese Maid Service

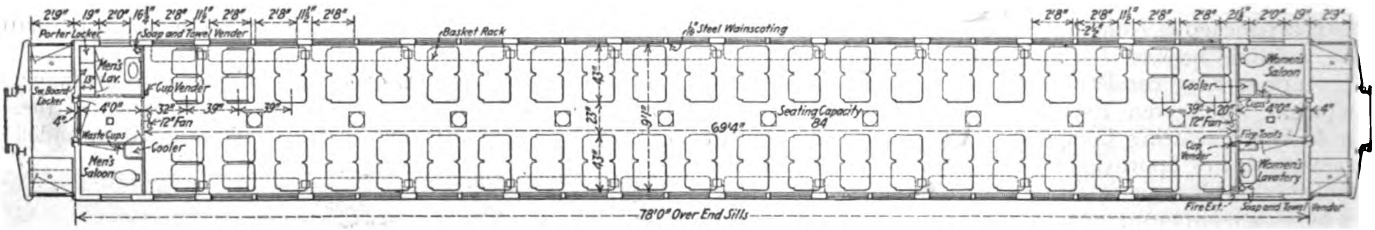
ft., respectively, and the inside length of the baggage compartment is 37 ft. This compartment is provided with a conductor's desk, lockers, baggage writing desk and a folding wash stand equipped with a mirror. The passenger compartment which is used as a smoker, seats 48. The seat design, which is similar to that used in the chair cars, is



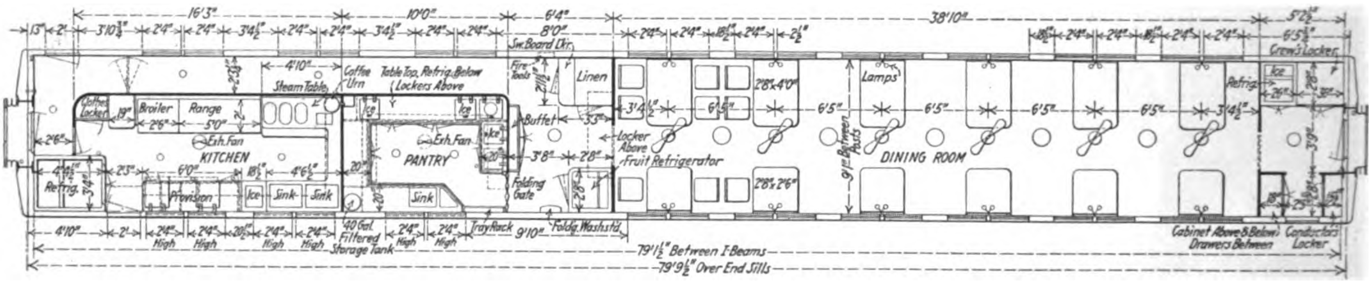
The Passenger Compartment of the Baggage Car Is Used As a Smoker



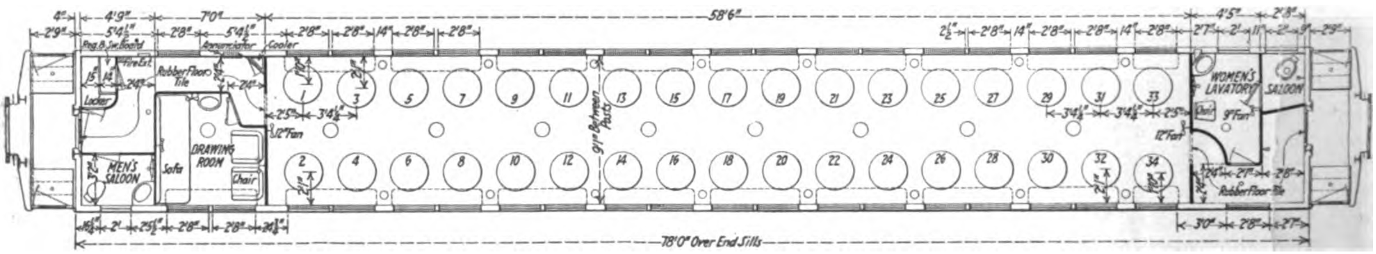
Floor Plan of the Mail Cars



The Chair Cars Have Individual Seats for 84 Persons

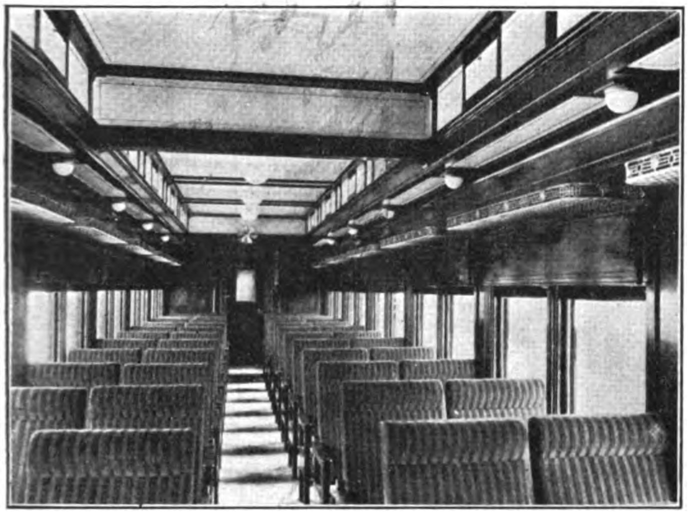


Floor Plan of the Dining Cars



The Parlor Cars Have a Total Seating Capacity of 39 Persons

quite unique. The frame is all metal with the exception of a wooden arm rest. The seats are divided, as shown in the illustrations, and are equipped with detachable seat cushions and backs, which are covered with leather. The interior is similar in general appearance to the parlor and chair cars which are wood, finished in vermilion. The wood finish is applied from the window sills up, including the lower and side decks which tends to give the cars a much more home-like appearance than if a steel interior finish had been used.



The Chair Cars Have Wide Upper Decks and Non-Reversible Seats

A separate saloon and wash room is located at the end of each car.

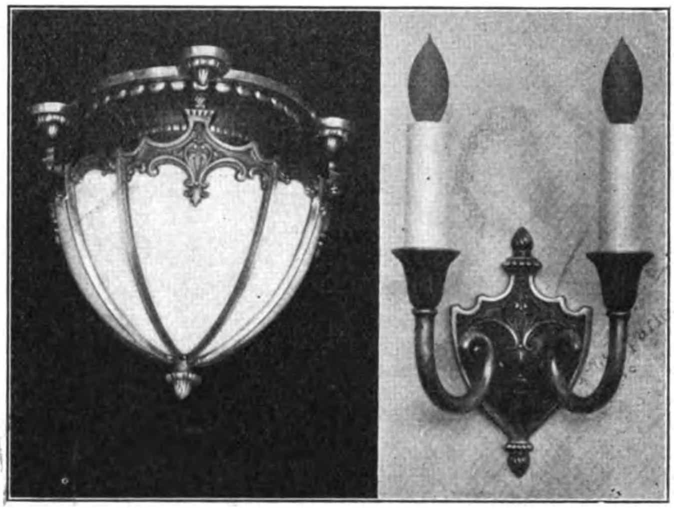
Two chair cars are used in each train, named for Oak Park and Evanston, suburbs of Chicago, and for Webster Grove and University City, suburbs of St. Louis. The over-all length of these cars is the same as that of the combination baggage and passenger cars. The seating equipment is the same as that used in the smoking compartment of the combination passenger and baggage cars, except that the seats are equipped with higher backs and are upholstered with green mohair. These seats, which were furnished by the car builders, are stationary and cannot be reversed, as the entire train is turned at each end of the road. As shown in the illustration, the center ceiling lights and the lower deck lights are placed on each side of the car. The upper deck is unusually wide, measuring approximately seven feet, which gives the car a roomy appearance. These cars are also equipped with separate saloons and lavatories, the men's being located at the front end of the car and the women's

are upholstered in mouse colored plush, striped with braided black. The draperies and carpets harmonize in color with the upholstery. The light fixtures are of statuary bronze and are arranged in a manner similar to that used in the chair cars.

A standard Pullman drawing room, seating five persons, is located at one end of each car, with a women's lavatory and saloon in the other end. The men's toilet is located in the same end as the drawing room. These cars have a total seating capacity of 39 persons each, which is exceptionally large for a parlor car.

The Dining Cars

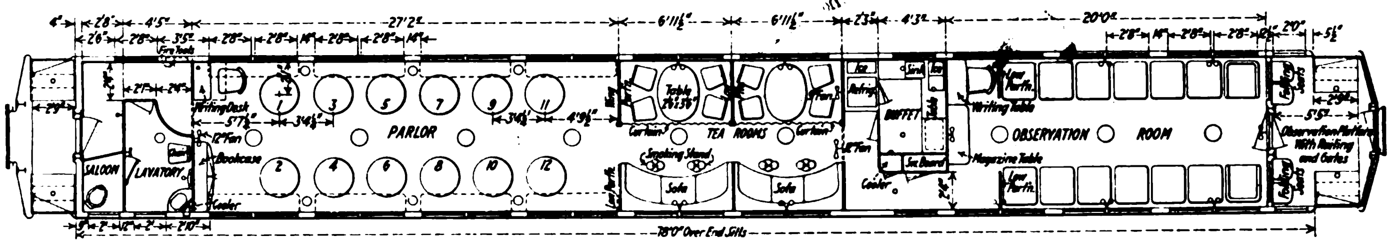
Each of the two trains has one dining car. These cars are named for Springfield, the capital of Illinois and for Bloomington, where the Chicago and Alton railroad shops are located. They have the same vermilion interior finish throughout, including the wooden passageway at the kitchen end of the car. There are ample lockers and refrigerators. Each car has a total seating capacity of 36. The interiors



Ceiling and Side Lights for the Dining and Observation Cars

are lighted with numerous candelabras and deck chandeliers of silver.

The kitchen and pantry are finished in white enamel. The equipment includes apparatus for the steam cleansing, sterilizing and drying of china, glass and other table utensils. The kitchen is equipped with an electric exhaust fan and reversible ventilators. All of the silverware and dishes are of special design. At the end of the dining compartment is



Floor Plan of the Observation-Parlor Car

at the rear. The aisle strips harmonize with the upholstering and window shades.

The parlor cars are named the George Washington, Thomas Jefferson, Abraham Lincoln, Grover Cleveland, Theodore Roosevelt and Woodrow Wilson. Three of these cars are used in each train. They are the same length as the combination passenger and baggage cars, and chair cars. Thirty-four revolving chairs are provided in each car. These

the conductor's desk with a cabinet above and drawers below. Immediately back of this desk is a conductor's locker and opposite is the crew's locker, together with a refrigerator equipped with a cigar humidor.

The Observation-Parlor Cars

The observation-parlor cars are of the most unique in design of any of the cars in the train. In the observation end is

a magazine table and writing desk with telephone service for use at Chicago and St. Louis, and 12 chairs. Immediately forward of this is a buffet, which serves a Japanese tea room and ladies' smoking room. Two enclosures comprise the tea room and along the side of the car opposite to these enclosures are two over-stuffed half-moon sofas provided with smoking stands. Draperies are hung at each end of the sofas, with a low partition between the two tea room enclosures and high partitions at the ends. In front of the tea rooms are 12 parlor car chairs which are for the exclusive use of ladies. A bookcase of special design, containing copies of the latest books, is located in the front end of the car, immediately opposite the writing desk. At the head end of this car is also a women's lavatory and saloon. No provision has been made for a men's lavatory or saloon in this car.

The upholstery in the ladies' parlor and tea room end of the car is of Venetian blue velvet. The upholstery at the observation end is of green velvet with carpet to match. The lighting fixtures in the entire car are similar in design to those in the dining car. Four folding seats, which close automatically as soon as the occupants arise, are provided for the observation platform. There is also ample room for the additional use of from four to six large camp stools with backs, which are carried as part of the equipment of these cars.

The exterior of the cars is finished in maroon with light Venetian tints striped with gold. With the exception of the postal, dining cars and the combined passenger and baggage cars, which are built with blind ends, all of the cars have wide vestibules. Pullman cast steel trucks are used throughout both trains. Each car is also provided with a Giessel water cooler, equipped with a filter.

Both of these trains were run intact from Chicago to St. Louis on September 14, where they were placed on exhibition the first two days of the following week. Both trains were placed in service September 28, one starting from St. Louis and the other from Chicago.

Economy in Painting Steel Passenger Cars

Twelve Years' Experience on Soo Line Demonstrates Practicability and Economy of Four Coat System

By G. H. Hammond,

Foreman Painter, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

In 1920 at Boston, the writer was privileged to read a paper on the economical painting of steel passenger car bodies, at the convention of the Equipment Painting Section of the American Railway Association, describing in detail how the Soo Line has cut out all needless material and labor used in painting, and at the same time secured greater durability. The paper was not prepared or published until after eight years of thorough test and practical use. At the present time, this system has been the standard practice on the Soo Line for more than 12 years, and not one of these cars has been re-sand blasted, and there is no indication that they will be for years to come.

Within the past four years, some of the other railroads, and at least one car company, have given this system (or as near it as possible) a try out with gratifying results, and are now strong advocates of the abbreviated paint treatment on steel passenger cars.

To all who are interested, the following will show in detail the system as practiced by the Soo Line:

The car is sand blasted to remove all old paint, rust and scale. This is followed by applying one coat of color paint on which the lettering is done, and is then varnished with three coats of outside body varnish.

The Tuscan red body color is in paste form, ground in equal parts of raw linseed oil and gold size japan. This paste color is thinned with raw linseed oil, and nothing else, to a consistency that will cover sand blasted steel with one coat. The color is applied with a bristle brush and smoothed with a hair brush.

The following day the car is lettered. First, pounce with whiting where the lettering is to be applied, and wash off with water after the lettering is done. The pounce powder will prevent the gold leaf from sticking to the body color around the gold size.

The next day the first coat of body varnish is applied. This is followed by two more, allowing 48 hours between coats.

These four coats are all that is necessary to thoroughly protect the steel from the weather. The body color is highly elastic, and will remain so as long as it is sealed in between the steel and the varnish, and will prevent the varnish next to it from hardening.

The four coats together, therefore, form a combined material of great elasticity which will expand and contract exactly with the steel, and cannot crack or peel.

Each time a car is repainted, the old surface is sand papered, given one coat of body color in oil, and three coats of finishing varnish precisely the same as a sand blasted car, saving the lettering as long as it is good. After two or three repaint jobs, it will be found difficult to distinguish these cars from those which have been surfaced.

Opposing Arguments Answered

There has been, naturally, some opposition to such a system. Some master painters have been opposed to using methods of this kind, giving various reasons in support of their opposition. Each and all of such reasons have been duly considered in the past, and are easily and logically explained away.

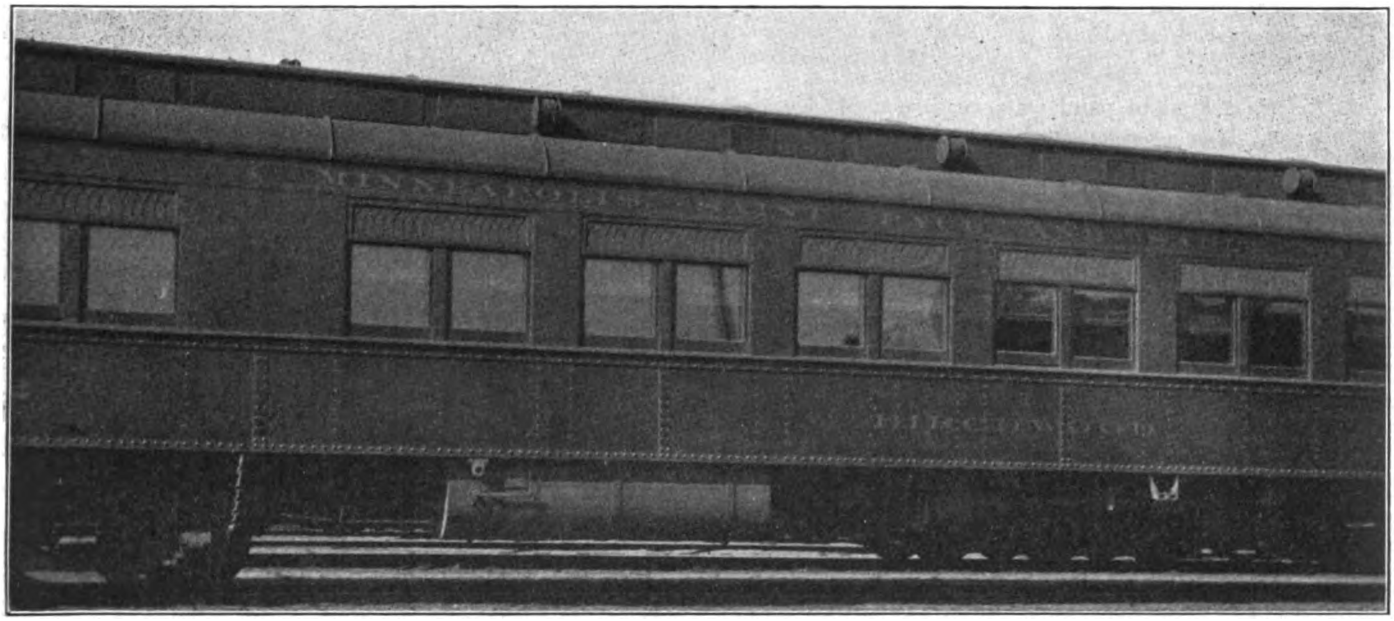
Some complain that the four coats applied in this way would not leave the car smooth enough in appearance to be acceptable, therefore, they insist that more or less surfacer be used to build up as smooth a surface as possible. Right here is the big mistake. Surfacer should have no place on the outside of steel passenger cars. As an exaggerated illustration of its nature, it may be compared to a layer of clay, non-elastic, brittle and porous, drawing the life from the under coatings as well as from the outer coatings. A break down of this combination is certain.

To turn out a car with a piano-like finish is a source of pride and satisfaction, of course. The value of such a finish consists of just one thing—advertisement.

Go to any train shed, or stand on the platform of any depot, and note if the passengers first examine the outside appearance of the cars in which they are about to ride. Clean cars with a varnish luster, whether super-smooth or

not, will impress railway travelers favorably. It is obvious that it does not pay to produce an extra smooth surface.

The objection has been made that a car finished with four coats only could not be wiped or cleaned readily. As a matter of fact, these cars may be cleaned just as easily as any other cars, and they are not noticeably rougher than other cars.

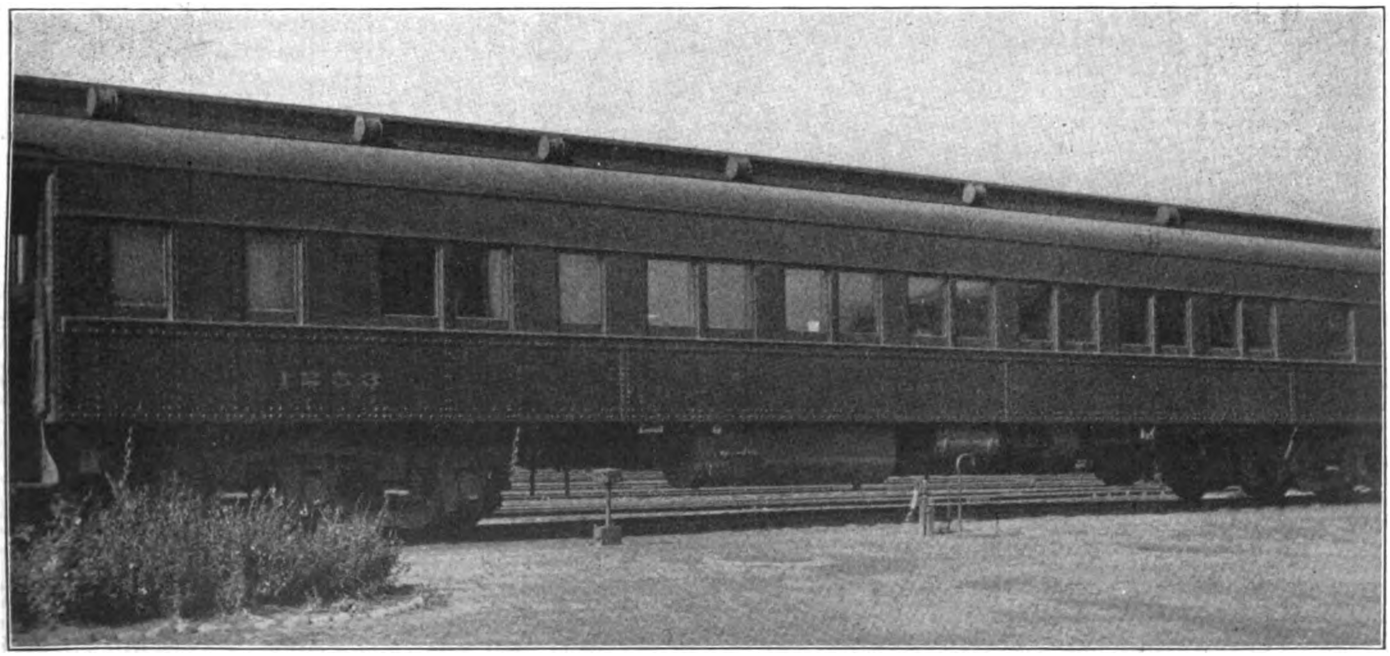


This Car Was Painted May 31, 1923

Another objection raised is that on some roads the steel used for the bodies is rough and full of pits. Such steel is objectionable for such a purpose.

Undoubtedly war conditions are to blame for many cars being built of such steel. It is believed that for some time past, and at present, any amount of good clean smooth steel may be had for car bodies. To those who have cars of rough steel where pits are not too numerous, the worst ones may be filled with solder and filed smooth, while the smaller pits may be ignored, as they will gradually fill as the car is repainted from time to time.

Still another objection has been offered that some of the body colors could not be applied directly to the bare steel because of lack of affinity between the two substances. This objection should not be considered too seriously, as a change of paint formula could be made which would overcome any difficulties of this nature.



Sleeping Car "Bowbells," Painted April 6, 1923

It has been claimed that the territory through which the Soo Line runs is especially mild on paint and varnish, while in some other parts of the country, the conditions are much more severe. A careful check-up will disclose the fact that climatic destruction to paint is about equal all over the continent, and any paint elastic enough to expand and contract with the steel will be found to be perfectly adapted to the mountain districts of the East and West, the hot plains of

the Southwest in summer, or the frozen prairies of the far North in winter. Some of the Soo Line steel cars are running between Chicago and Vancouver, and show no more deterioration to paint than the same class cars in local trains.

The advantages of the four coat system are:

Greatly reduced cost of materials.
Less cost for labor.
Increased durability of paint.
Less time required to paint the cars.
Greater time between sand blasting jobs.

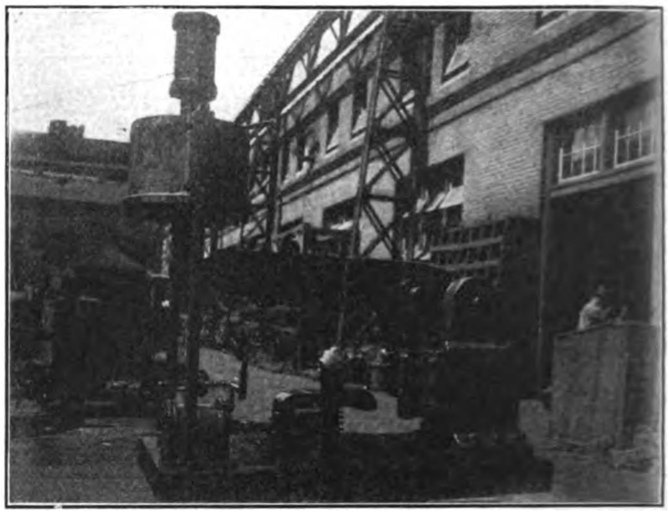
If the right kind of paint materials are used, success is certain.

Coupler Yoke Rivet Shearing Machine

By E. A. Murray
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

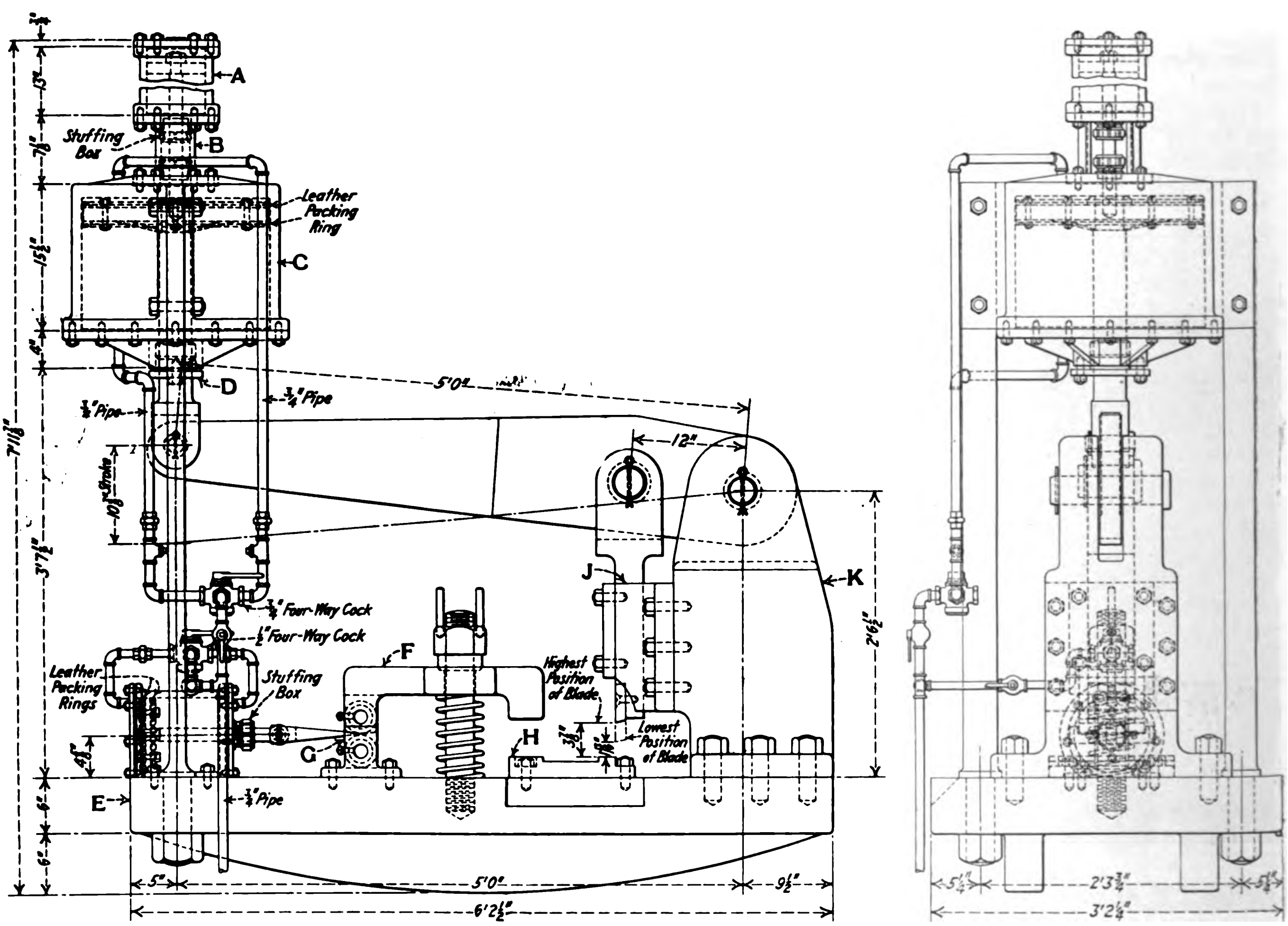
To replace a coupler yoke it is the customary practice to remove the whole gear and take out the springs and followers. The yoke and coupler are then sent to the blacksmith shop where the rivets are cut off and a new yoke is attached. In order to expedite the work of removing the coupler yoke rivets at these shops, a pneumatic shearing machine has been devised which has considerably reduced the time and labor formerly expended in this work.

Referring to the drawing, it will be seen that the machine consists essentially of a large air cylinder for operating the shear, a small air cylinder for inserting the clamping wedge at *G* and a bolster and clamp for holding the coupler and yoke. Cast iron and wrought steel have been used throughout the construction with the exception of the parts *F* and *H* which are made of cast steel. The assembling and piping pertaining to the installation were performed in the shop.



Pneumatic Rivet Shearing Machine Which Saves Considerable Time in Making Coupler Repairs

The main air-cylinder piston rod which is 3½ in. in diameter, is pivoted directly to the shearing lever. A smaller piston rod, 1⅜ in. in diameter is screwed into the upper end and operates a piston in the oil cylinder *A*. The oil cylinder is bored to 6¼ in. and is 13 in. high. The oil serves as a



Drawing of the Coupler Yoke Rivet Shearing Machine

buffer to cushion the action of the main piston when air is admitted to the cylinder *C*. A stuffing box *B* is placed between the oil and air cylinders. The diameter of the main air cylinder is 20 in. and the piston stroke is 10⅜ in. The shearing lever is fulcrumed on *K* and the blades are bolted to the shear head *J*. The coupler yoke is held in position on the bolster *H* by the clamping lever *F*. This lever is held against the yoke by means of a wedge inserted between two rollers at *G*, by admitting air into the air clamping cylinder, which is bolted to the end of the bed plate *E*. When it is desired to release the clamping lever, it is only necessary to turn a four-way cock which admits air to the other side of the piston in the air clamping cylinder and also releases the air which was used to move the wedge forward. The return movement of the piston removes the wedge from between the two rollers and a spring pushes the clamping lever up.

Both air cylinders are operated in the same manner and the various cocks are located in a convenient location for the operator. The coupler yoke may be placed on the bolster and removed from either side. This arrangement is quite convenient in case either one or two men are working, as the machine may be operated entirely from one side or from both.

Discussions at the Car Inspectors' Convention

Accuracy of Charging for Repairs to Bent Car Parts and Responsibility for a Shifted Load Discussed at Length

LAST month's issue of the *Railway Mechanical Engineer* contained a resumé of the opening proceedings of the twenty-third annual covention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America which was held at Chicago, September 23, 24 and 25. One of the papers included in that issue was that of B. F. Jamison on A. R. A. Car Repair Billing. Below will be found an abstract of the discussion which followed its reading. The Question Box discussion is also given in this issue.

Discussion of Mr. Jamison's Paper

F. W. Brazier (N. Y. C.): I was much interested in Mr. Jamison's paper, but he is talking to the wrong convention. Our higher officers are the ones who do not know the importance of what he has said. I see our billing clerk here. How many million dollars a year do you bill out?

A Member: Approximately $15,000,000.

Mr. Brazier: That is more than the entire mechanical department is spending on our fast locomotives. When you get home take this up with your higher officers and when they say you must cut down expenses and lay off some of your men, explain to them that it will be taking money out of their own pockets. You know, as a general thing, when they want to lay off anybody, they start in the car department.

We have no rule that is so abused as Rule 32. I do not believe some of the decisions that the arbitration committee made, and I am a member of it, would stand water if the people told the truth, but we have to render a decision on the evidence given us by you.

J. J. Gainey (Southern): Mr. Jamison at one time was under my supervision in the car department. Unfortunately from the mechanical end, he left us and went into the auditing end. He checks in about eight general foremen's districts, which will mean eight general car foremen and probably treble that number of foremen of the car department. He is more rigid and severe on our mechanical department than the A. R. A. clerks. He checks us from every angle, even going out into the yard and checking the repairs to the cars.

He makes out a statement, one copy of which comes to me, one of which goes to our superintendent of motive power and one to our auditor. He shows all errors and omissions, under and over charges, and brings it all out in dollars and cents. He sends that in to our office and I presume our office at Washington sends a check out for all the over charges and we make our men go back and check the undercharges and bring them up. Any road that has not got a billing repair auditor is making a mistake.

Whenever he checks in a terminal he takes the general foreman out to where the inspectors are who write up those repairs and instructs them. He also gets a class of all the foremen and supervisors and talks to them if I am not there. Mr. Jamison has been a great help to the mechanical department on our railroad.

W. P. Elliott (T. R. R. A. of St. L.): May I ask, in steel car repairs where you have two different charges, one on a riveting basis and the other repairing on the car, how you divide the two?

Mr. Jamison: In the majority of cases that work is done by different men and the foreman and the work checker keep the time, with of course the assistance of the repair man himself. It is rare that the man who does the riveting does the straightening or repairing on the car.

Mr. Elliott: Our situation is different, because we have all foreign cars, and as a rule one gang cuts down in a progressive fashion and another gang fits up. That same gang when they fit up do whatever straightening is to be done on that car. We carry separate books and of course we have to rely to a large extent upon the man too. Is there anything wrong with this system that you can see?

Mr. Jamison: No. According to the regulations there should be no memorandums or records other than the original records of repairs, but I do not think that you are getting away from that if you allow, for instance, your acetylene operator to keep the amount of gas that he used on the car. Those are not original records. The original record refers to the information that is going to be given to the bill clerk. Our acetylene operator carries a book in his pocket; but each day, each hour or two, the original record man is getting that information from him and that would be the same way with your man-hours.

E. Pendleton (C. & A.): Isn't there a charge in the rule for straightening sheets?

Mr. Jamison: Yes. If the part of the car is straightened on the car it is on the hourly basis. If it is taken off the car and then straightened it is on the pound basis.

Mr. Elliott: In the operation of the acetylene welder, suppose you get a bent bolster. How do you divide that time? Your acetylene man gets a higher rate. Do you allow the blacksmith so much for straightening and the acetylene man so much for welding, or do you follow the practice of having the acetylene man do both?

Mr. Jamison: In the majority of cases he does both.

Mr. Elliott: Then you charge his time?

Mr. Jamison: Yes.

Mr. Elliott: There are a few cents difference, but it

works out about the same way. We do that and I have always thought it was a proper practice.

M. E. Fitzgerald (C. & E. I.): I do not understand the connection between the acetylene welder and the blacksmith in repairing a bent bolster, for the simple reason that the association does not recognize any difference between crafts in repairs to a part of a car. If you repair a bent part of a car you repair it on a labor basis, so much per hour regardless of who performs the operation. In welding you charge, of course, according to the material you use and the labor consumed. I think you have confused your question.

Mr. Jamison: Mr. Fitzgerald is correct. He has just gone a little farther than I thought your question intended to go.

Mr. Fitzgerald: There is really a decided difference between repairs and welding. Unless the car foreman in charge of the work understands the rules and charges the billing clerk will be absolutely confused in rendering his charge, when it reaches his office.

Mr. Elliott: I do not think I can make myself any clearer. We have presses. You do in your shop too. A bolster comes in there to be welded and it is bent. Your acetylene man does the entire job instead of turning it over to the blacksmith to be straightened and then brought back for welding. You charge so much per hour for welding plus the material.

Mr. Fitzgerald: There is a decided difference between repairing a bent bolster and welding. They are two separate and distinct charges and the record has got to be compiled so that you can clearly differentiate between the two, and the billing clerk must have that information in order to render his charges properly.

Mr. Gainey: If I understand Mr. Elliott he is speaking of a case where in heating the bolster preparatory to welding, the steel comes back to its place.

Mr. Elliott: You would not dare to charge, so much per pound for straightening and then in addition to that charge your welder's time too. You would just charge your welder's time on an hourly basis, plus the material. There isn't any limit to what you can charge for welding if you want to. The rules do not say.

Mr. Gainey: I think Mr. Elliott is absolutely right because the bolster straightens itself in the heating, and if he just charges on the hourly basis he is not overcharging. He is doing the work.

G. Reichart (C., M. & St. P.): In welding and straightening, how do you arrive at the amount of acetylene to be charged? Do you have an arbitrary charge for acetylene per hour or do you actually measure the acetylene you are using? We have an arbitrary charge of 75 cents an hour; that is, for the time that the welder actually works. We have an additional average charge of 75 cents for the acetylene and oxygen to be used.

Mr. Jamison: We use the gages.

Mr. Reichart: What does your average amount to?

Mr. Jamison: It varies. I am not very well satisfied with it. I am working with it right now, getting figures at different places. We do use an average charge of 25 cents an hour for electricity, which is just about one-third as much as it costs us, to my notion; but for the acetylene and oxygen gases we are using the gages.

Mr. Smith: We have occasion to check our inspectors and write-up men to see that they get all of the charges, and I was wondering how that was handled on the Southern.

Mr. Jamison: We can only check a portion of the yard inspector's work, that is true, because the cars are coming and going; but we feel that we get a sufficient amount of it so we will keep him lined up.

Mr. Smith: What I had in mind particularly was the fact that if you check the man in the train yard to see that he has charged everything, you will go along and find a new nut or a new shoe or a new shoe key, which looks very much as though it has just been applied, but when you go to the man he says, "I didn't apply that." What are you going to do about it?

Mr. Gainey: You must watch him and instruct him and educate him to charge everything he does, but nothing he does not do.

Mr. Smith: They are in a hurry sometimes.

Mr. Jamison: I would like to say, Mr. Smith, I don't know which we have worked on harder, "Don't charge what you don't do," or the other, "Be sure to charge all that you do."

Mr. Fitzgerald: If I was in doubt I would check the issuance of material to that particular inspector and find out if he carded me on system or foreign equipment for the particular amount of equipment issued to him for thirty days. But I would not permit an A. R. A. inspector to question whether he did or did not apply it, as to whether it was new or old. He does not know. We have got to give the car inspector a little consideration in our yards.

J. L. Flood (N. Y. C.): Mr. Jamison, on your road are the billing repair cards in the bound cards?

Mr. Jamison: Yes, sir.

Mr. Flood: And the billing repair card is numbered?

Mr. Jamison: Each billing repair card is numbered consecutively.

Mr. Flood: If you have more than one card how do you cover that?

Mr. Jamison: We staple them together.

Mr. Flood: What is accomplished through the numbering of the bill repair cards consecutively?

Mr. Jamison: When the billing cards are issued to the mechanical office from the stationer, he notifies the auditor of disbursements in Washington that he is shipping billing repair cards from number *X* to *Y*, inclusive, to this division, represented by the master mechanic's office. The auditor of disbursements holds those numbers against that district until the billing repair cards have been furnished him completed. We have a system for that which requires but little work. With each bundle of billing repair cards which have been completed that are forwarded to the office of the auditor of disbursements we have a form called 1043. It says, "Herewith billing repair cards in valuable package number blank, from such a date to such a date, from such a number to such a number inclusive."

Mr. Flood: Are your original records covering repairs made in your train yard numbered?

Mr. Jamison: No.

Mr. Flood: What protection have you against destroying the original record?

Mr. Jamison: We use the loose leaf form of original records in all of the work. We require that every yard car inspector, light repairman and air brake man, turn in one sheet each day, dated and signed. If he made no repairs during the eight hours that he was on duty he must write across the face of it, "No repairs made."

Mr. Flood: Do your original records cover the repairs to more than one car?

Mr. Jamison: Yes. The sheet is full letter size.

Mr. Flood: Then if the man made twelve repairs, eight on one sheet and four on another, your car charger, if he wished, could destroy the sheet with the eight repairs on it in order not to bill on them and you would be none the wiser.

Mr. Jamison: Our original record sheets have a numbering system up in the corner. The inspector or the write-up man who handles the original record, if he uses three sheets today, says on the first sheet, "Sheet No. 1 of three sheets." The second is "Sheet No. 2 of three sheets." The last one is, "Sheet No. 3 of three sheets." If he destroys a sheet he is going to have to change one of those numbers, and that would be evidence for a little quiet investigation.

Mr. Flood: Don't you think it would be a good plan to

number your original records as well as your billing record cards consecutively?

Mr. Jamison: We are considering that and have been for some time. It will probably be done some day, but I am not really sure of it. Personally I feel that we are getting along fine with that part of the work.

Mr. Flood: Have you run across clerks that have destroyed the original records in order to shirk their work?

Mr. Jamison: Not since we have the loose leaf system. When we had the old books we did.

Mr. Fitzgerald: Mr. Jamison, on the record receipt that he referred to, made no reference other than to say he was forwarding repair card numbers one to blank, with no reference to possible attachments of joint evidence or defect cards. It might be well to bring before the association the fact that they also should be shown on that transmission receipt form between the auditor and the car inspector, for the reason that should he send twenty repair cards, three of them supported by joint evidence or defect cards, it should be shown on that receipt. They might be misplaced in transit.

Mr. Jamison: Our form 1043 also lists the defect cards included in that package, and also our own system defect card stubs which we remit to the office of the auditor of disbursements. We do not lose our joint evidences. They are attached directly to the repair card which was issued in that case.

Mr. Fitzgerald: Should they become detached the billing clerk in the office might be confused in rendering his charge.

(On motion of Mr. Sternberg, Mr. Jamison was given a rising vote of thanks for his paper.)

Question Box Committee and Discussion of Billing Rules

W. M. Pyle (S. P.): This committee yesterday at the suggestion of the chairman of the executive committee invited Mr. Fitzgerald to sit with us in considering these questions and he did so and concurs in the different recommendations or interpretations as made by this committee.

The first question that I have concerns a load of brick. It is not in the form of a question but it is a letter. I will read it.

Question No. 1—Brick, when loaded in accordance with the A. R. A loading rules, does not require door protection; in the cases at hand the brick had originally been loaded in accordance with the loading rules but had shifted in transit. The Pennsylvania reloaded the brick to conform to the rules and did not apply inside door protection as it was not necessary.

The fact that brick, properly loaded, does not require door protection, in our opinion, removes it from the provisions of A. R. A. Rule 2, paragraph (h).

Answer—It is the decision of the committee that a shifted load is a delivering line's responsibility. Originating lines can only be billed if door protection is applied.

G. Ziebold (H. V.): I will agree with the gentleman that a shifted load is the delivering line's responsibility, but there is an exception in paragraph (d) of the car service Rule 14, requiring door protection for any load rolling, shifting or coming in contact with the door in transit. That is the accepted rule.

A. Armstrong: (chief interchange inspector, Atlanta): How are we to determine that this load was loaded originally according to the loading rule? We will take it for granted that it has passed over 400 miles of road and the doors are in distress. We find that the brick is piled up against the door. How are we to determine that the brick was loaded in accordance with the rule?

Mr. Ziebold: Only from the claim of the line that claims the deduction. The man in charge of the adjusting order tells you that the car was loaded in accordance with the rule. We have got his ruling.

Mr. Fitzgerald: The question as written plainly indicates to us that the car was originally properly loaded in accordance with the rules of loading.

A. F. Owen (L. & N.): I would like to know how any one can tell when a load becomes shifted against the door whether it was properly loaded at the originating point or not. Circular 311, I believe it is, makes the originating point responsible for door protection, and it says it must be applied in the substantial manner so that the load cannot shift in transit and come in contact with the doors. If the door protection was properly applied it should not shift and come in contact with the door. Neither would the door protection become dislodged and allow the load to come against the door. I believe if any load is shifted against the doors, not in unfair usage, a bill is properly rendered against the originating point.

B. F. Jamison (Southern): Just in case he should apply inside door protection. Otherwise his bill would be void.

Mr. Owen: I believe that any load that can shift against the door should have door protection originally, and if it cannot shift against the door you will not find it against the door.

J. E. Vittum (chief joint inspector, Columbus, Ohio): This question comes from our interchange district and therefore I have a part in this discussion. It was brick which I understand originated on the C. & O., was delivered to one of our railroads in Columbus, and when it passed the receiving line's inspection point, it was found that part of the load had shifted against the door. Of course, our inspectors are not permitted to break seals or to examine the load and know whether or not it is loaded in accordance with the requirements of the loading rule. But the load was disarranged; it had to be moved to the shop for proper adjustment. It moved to the receiving company's shop and there it was found when they opened the door that the brick had been properly loaded according to the requirements of the loading rules. Nevertheless that did not hinder some of the load from shifting from its regular place and falling against the door. Therefore, it became a necessity to adjust the load. According to our opinion it had been improperly handled. Therefore, since the delivering line did something, either by unfair usage or otherwise, so that part of the load, although properly loaded in the first place, did fall against the door, we thought it sufficient authority to issue adjustment orders so that the load might be adjusted in such a way as to require no loss of lading as the load moved forward.

Mr. Ziebold: Was there any evidence of that car being in trouble or roughly handled? Was any brick damaged? Bricks have to be properly loaded to be loaded in accordance with the loading rule, and they certainly were not thus properly loaded, in my opinion, or they would not have shifted.

Mr. Vittum: My attention was not called to the load before the adjustment was made, so we had to take the word of the receiving line. The conditions which surrounded the case would imply that there was improper handling of the car.

T. J. O'Donnell (chief inspector, Niagara Frontier Car Inspection Bureau): The setting of brick according to the loading rule does not prevent shifting. I think your committee has solved this the only way they could do. The delivering line is responsible if the originating line stepped the brick at the doorway as the rules demand. I was going to recommend, when we make our changes in the rules, that this rule be amended because brick will not stay in place on the stepping arrangement that the association has outlined.

Mr. Fitzgerald: Mr. O'Donnell has practically covered the conditions, as they exist, and the committee I feel have properly handled the question before them. I believe the executive committee will welcome a recommendation to be later placed before the loading rules committee to correct or amend the present loading rules to provide for door protection for brick so it absolutely will not move in transit if loaded according to the rule.

C. F. Straub (Reading): I move that the committee's recommendation be accepted.

(The motion was seconded and carried.)

Question 2—Wooden underframe car is received from the connecting line with four broken longitudinal sills and handling line breaks two additional longitudinal sills. Does such a car come within the scope of the footnote under Rule 43, and if so how can the handling line comply with the requirements as to furnishing the car owner with a statement as to the circumstances under which the damage occurred, except for the two sills damaged in its handling of the car? In the absence of a receiving interchange record of the old sill damage, would personal inspection by the chief interchange inspector be sufficient to prove that part of the damage occurred prior to receipt of the car and absolve the handling line of responsibility for the old damage?

Answer—The handling line is responsible. We did not attempt to answer those other questions regarding the method to be employed in finding out about the other sills that were damaged.

J. J. Gainey (Southern): I move that the interpretation of the committee be accepted.

W. P. Elliott (T. R. R. A.): I do not agree. I asked the question. The question was if we received the car with three broken sills and we broke three more. The rule says the company on whose line six sills become damaged (there were not six sills damaged on either fellow's line) must furnish the owner a statement. We claim that is the owner's responsibility. The only thing they would be required to do in that case would be to prove by an interchange record or an inspection that that car was received with three broken sills. I think that the arbitration committee that made these rules contemplated that you must break six sills before it was a handling line responsibility. In this case you are not breaking six sills. Another fellow will put up the argument that you could have protected yourself when you took that car. I would just like to call you back. What would you say of a man who stopped every car with three broken sills? You would say he was crazy. I claim the rule is intended to take care of just such a condition that if you do not damage six sills you cannot give this man a statement and you do not have to. Under the rule I claim that that car was not unfairly handled as contemplated in Rule 32.

Mr. Fitzgerald: The arbitration committee says that when the car on your line develops six broken sills you must tell the owner how the damage occurred. The arbitration committee, through the various associations, have given us Rule 2, which is that empty cars offered in interchange must be safe and serviceable. The car was received with four broken sills. He had the option of transferring it if it was loaded and returning it to the delivering line, properly protecting it against further damage. If it had burned up he would have been responsible. If he had further damaged it he was responsible. He had the option if the car was empty of rejecting it. He did not do so. He operated the car and further brought about a combination of six broken sills and he must say how he broke those six sills. Four of them were broken when he received it. Now if in handling he broke two further sills he must clearly define to the owner of the car how that car was operated and he has no question before him except to show that he gave the owner fair service. In the absence of that information he is responsible to the car owner for complete repairs to the car; and if you refer to arbitration decisions you will find that the old sills have no significance whatever in settling such a question. There are numerous arbitration decisions to the effect that if he handles a car with broken sills he is handling the car improperly. He should have repaired it and billed the car owner.

A. S. Sternberg (B. R. C. of Chicago): I would like to go along with Mr. Elliott if it was possible. I think the handling line will be held responsible in a case of that kind. It is a very unfair proposition especially to a switching line, because we get cars from trunk lines every day with two to three sills broken and in handling and switching them we probably break a couple more. I do not believe we can get out of it. I believe that the handling line will be held responsible.

Mr. Elliott: The rule does not say that "if the car develops six broken sills." It says the company on whose line those six sills or any six sills became damaged. There isn't any arbitration case similar to this. I think the decision of the committee is wrong according to the rule. I do not believe the Arbitration Committee ever intended that in a case like this the handling line should be responsible unless they actually damage the car.

Mr. Jamison: According to this rule he must furnish the car owner with a statement. Now what would this particular line's statement be? It would be a copy of the interchange record, showing that four sills were broken before the car was delivered to him and two subsequently, and it seems to me that any fair car owner ought to accept that statement. The owner, when he gets a bill from you for six sills, is entitled to a statement. Your statement should only be as far as your knowledge went, which in this case would be perfectly clear, that you received the car on interchange with four sills broken and broke two later.

Mr. Fitzgerald: Mr. Jamison is in a sense correct. The only thing required of the railroad that handled this particular car is to show it received the car with four broken sills and that it handled the car absolutely fairly in accordance with Rule 32. Now reverse the same proposition and accept the car in first class condition, with no sills broken, and break the six sills on the Terminal Railroad of St. Louis. If you can show to me that you handled that car fairly, according to Rule 32, we will accept your bill for the six sills or we will authorize you to destroy the car. I cannot see any argument with the two sills versus the six sills. It is not up to the car owner to question the man as to how he received the car. It is as to how he handled it after he got it on his line. He must move that car in such a manner that he will not violate the provisions of Rule 32, and if he does that we have all got to pay him if he damaged eight sills in the car or broke the car completely in two.

(The members voted in favor of the decision as rendered by the committee.)

Question 3—Rule 32, fourth paragraph, Section D, reads: "no rider protection *when necessary*, if car is damaged to the extent shown in footnote to Rule 43."

Define clearly the circumstances under which rider protection *is necessary*.

Answer—When cars are handled over hump or cut loose from engine while in motion, such as kicking or dropping cars.

(On motion, the answer of the committee was approved.)

Question 4—What is considered the safe limit of speed for switching in a classification yard without rider protection?

Answer—Beyond the committee's jurisdiction.

(On motion, the interpretation by the committee was accepted.)

Question 5—If derailment is due to any of the following reasons, should the car owner be billed for expense of repairs for any damage occurring before said derailment?

1—Coupler or attachments pulling out and falling to rail.

2—Car breaking in two, then derailing or parts of body falling to ground.

Answer—It is the delivering line's responsibility.

A. G. Lyon (N. Y. C.): The owner would be responsible for the coupler pulling out that causes the derailment. For any damge before the derailment it is the owner's responsibility.

A. F. Owen (L. & N.); There is a provision in the rules for the owner being responsible. Therefore, the coupler itself would be on the owner's responsibility. I think there should be two decisions on that. They are two independent questions. One is a question of damage to equipment due to a coupler pulling out or a coupler breaking, and another is due to a car being derailed. All the decisions ever rendered by the arbitration committee made a derailed car a handling line responsibility, and their decision on a coupler pulling out, damaging an axle, bending or tearing off brake beams or other like damage to the car makes the owner responsible.

J. J. Gainey (Southern): I think the report of the committee is correct. If in backing down through the yard a freight car breaks in two by buckling and one or two wheels drop to the ground you cannot charge the owners for the sills.

Mr. Fitzgerald: The provisions of A. R. A. Rule 32, plainly read that if a car is derailed, cornered or side swiped, the handling line is responsible, and I believe that if the gentleman who made the issue in this particular case will refer to arbitration decisions he will find 40 to support our argument and the argument of this committee to the effect that when a car is derailed the car owner must be paid by the

handling line for all damage. If you will just look at the situation clearly and fairly, we would evade the issue in 90 per cent of the cases if we had access to the argument that the car broke in two before it derailed. Whenever the car is derailed the handling line pays the bill, and there are numerous cases to support our argument.

Mr. Elliott: I do not see how Mr. Gainey can reconcile himself with the decision of the committee on Rule 41 when they say the car was found damaged with other defects which are ordinarily owner's responsibility. Such defects may be repaired at the car owner's expense. This car we speak of here is a flat car broken in two, with one pair of wheels derailed. The rule says very plainly, "If caused by derail." Up to that time it is the car owner's proposition. After that the car handler's. Prior to that time we can bill the owner. After that time we cannot bill the owner. That is what Rule 41 says. I do not see how you can take another position. I remember one of these representative cases that you refer to. It says the car was derailed and damaged. I am talking about a car that was damaged and derailed. Your case was just the reverse of the case I am talking about.

Mr. Smith: I agree with the sentiment expressed by Mr. Gainey. We bill for broken wheels. Say, for instance, the car is descending a mountain and the wheel breaks and causes a derailment, we bill for that wheel. We bill for a truck side that fails. We bill for a coupler that fails. But we have not gone as far as going into any such damage as breaking the car in two.

Mr. Elliott: I do not believe we ought to go on record as deciding a case so contrary to the rules as that. It will look bad to any one.

B. F. Jamison (Southern): My instructions from my superiors are to see that only just bills are rendered on our line. Whenever you get into that close box of having a damage that occurred previous to a derailment and during derailment you are getting down so fine that somebody is going to slip if you do not take the safe line. My instructions wherever I go are to take the safe side, and if the car was derailed we make a no-bill.

(*The members voted in favor of the committee's decision.*)

Question 6—Should we get three-tenths of an hour per bolt for short bolts used in repairing running boards on tank cars or should we be paid on a bolt basis?

Answer—As per items 91 and 91-A of Rule 107.

Question 7—What service metal is to be shown on a repair card for steel wheels applied that are not full flange contour?

Answer—The amount of service metal as shown by wheel gage after wheels are turned to full flange contour.

Question 8—We issued a defect card for a cut journal and owner changed wheels, charging us for a new axle less S. H. Can owner charge us for betterment to his own car, 1923 repairs?

Answer—No.

This has to do with Rule 86.

Question 9—Where axle is removed on account of delivering line responsibility with wheel seat below limit of wear and is replaced with one having all required dimensions, who is responsible for the difference in value?

Answer—The delivering line is responsible.

Question 10—Where axle is removed on account of delivering line responsibility and wheels condemned with remounting gage, who is responsible for value between scrap and second-hand?

Answer—The delivering line, interpretation No. 3, page 108, Rule 98.

Question 11—Rule 91. Should offset or recharge authority be given for an amount less than 25 cents if it is found that car on which charge is made was not on line of billing road, on the date of bill?

Answer—Yes.

Question 12—Rule 17. Is application of a 5-in. by 7-in. coupler in place of a 5-in. by 5-in. wrong repairs where provision is made or exists for ¾ in. in clearance of coupler shank?

Answer—Yes.

Question 13—Rule 60. Should offset or recharge authority be given for not obliterating old stencil marks, in connection with cleaning air brakes, where the second cleaning is done 9 or 12 months after date it is claimed was not obliterated?

Answer—Yes.

Question 14—Rule 11. Is there any method of determining the thickness of lining in journal bearings other than gaging prior to rebabbitting?

Answer—No.

Question 15—Rule 12. Should defect card be requested on joint evidence obtained more than 90 days after first receipt of car home?

Answer—No.

Question 16—If a 5-in. by 7-in coupler is applied in place of a 5-in. by 5-in., or if a 5 in. by 5-in. shank, 9⅛-in. butt coupler is applied in place of a 5-in. by 5-in. shank, 6¼-in. butt coupler and shortly after the wrong coupler is removed broken, is repairing line (car owner or foreign company) justified in charging for new or second hand coupler according to what is applied and allow credit for scrap body on authority of the defect card covering the wrong coupler applied?

Answer—Allow credits according to condition of parts of coupler removed, charging either for new or second-hand according to which is applied. This has to do with Rule 91.

Question 17—Rule 91, paragraph C, states: if exceptions do not amount to 25 cents in the aggregate, no exception shall be taken.

Some companies are taking exceptions to wrong car numbers when aggregate of charge is as small as five cents and insist that paragraph C does not apply to wrong car numbers. What is the opinion of the committee in this respect?

Answer—Paragraph C does not apply to wrong car numbers.

Question 18—If air brakes are cleaned the second time within nine months and the repair card of the company doing the last cleaning shows old stencilling which does not agree as to date and name of the company performing the previous cleaning, will Arbitration Case 1278 apply or does the card of the company doing the last cleaning act as joint evidence showing that the company doing the first cleaning failed to stencil car properly?

Answer—Intermediate road's repair card acts as joint evidence and is final.

Question 19—Some companies, prepare repair cards covering repairs to their own equipment and match it with repair cards they receive from other companies. There are numerous instances where companies doing so use their repair cards as joint evidence showing that cars are not stenciled for D type couplers, and that D type couplers were not applied.

Are we to accept such evidence as final and within the spirit of the rules when such cards are submitted with repair cards covering repairs made six months or two or more years previously and showing D type coupler applied and car stenciled?

Answer—No. Owner must secure joint evidence within 90 days.

Question 20—A road submits joint evidence as follows: Repairs made—One. A. R. A. standard; 2, brake beam, top hung. How repairs should be made—One, A. R. A. standard; 2, brake beam, center hung.

Should defect card be issued? If so, what should it cover and what charge should be made on authority of the defect card after the alleged wrong repairs are corrected?

Answer—Labor only.

Question 21—Through oversight, statement as required by Rule 43 is not furnished car owner with bill. On complaint from car owner the repairing line furnished the statement, which is accepted as showing the circumstances under which the damage occurred; however, car owner declines to accept charge on account of failure to attach statement to repair card when bill was presented.

Is car owner's action warranted by the spirit of the rules?

Answer—No. However, repairing line should have complied with Rule 43. It was the opinion of the committee that the decisions of the arbitration committee allow the correction of a repair card when it complies with the original record, and it was the opinion of the committee that this was just the same.

Question 22—What is the proper charge for a National metal bound door for ordinary box car?

Answer—Item No. 147. $11.20 each.

Question 23—What is the proper charge for a reinforced door having two longitudinal metal stiffeners and one vertical metal spark strip?

Answer—Item No. 148. $18.75.

Question 24—What is proper charge and credit when Westinghouse friction draft gear is removed on account of spring and segments broken and Miner friction draft gear applied instead? It is understood that all parts of gear removed are good except segments and spring.

Answer—Scrap and second-hand for parts removed.

Question 25—What is the proper charge when a National metal bound door is removed from the car and all door siding and battens are removed on account of decay, and the bolt labor and material exceeds the price of new door? What would be the proper charge if same door was missing?

Answer—$11.20.

Question 26—If a defect card was issued to owner for wheels and axles missing, would the charge be proper for value of new wheels and axles or second-hand value?

Answer—Second-hand value.

Question 27—Is it proper to charge McCord and National journal boxes at manufactured price per Rule 105 or on a pound basis?

Answer—Pound basis for malleable iron.

Question 28—Does the price of journal box include the lid, or should the lid applied be charged separately and credit be allowed for lid removed separately?

Answer—No.

Question 29—When billing for repairs made to tank car on authority of a defect card must the labor for each operation be shown or simply lump sum hours covering boiler-maker work on tank shell? Some companies show the actual hours for each operation on the shell while others only show total hours worked on the barrel.

Answer—Where available, labor should be shown separated for each operation.

Question 30—Road *A* cleaned the air on *B* car, 9-29-23. Road *C* cleaned the air on this same car 6-17-24 and reported the old date as 6-29-23 by *A*. Is the *C* repair card evidence that *A* did not properly stencil the car or is the *A* repair card evidence that *C* misread the stenciling applied by *A*? Does the principle involved in arbitration case No. 1278 apply?

Answer—Yes. Rule 90 must apply.

Question 31—Road *A* cleaned air on *B* car 46,789, 6-14-23. Road *C* cleaned air on this same car 6-18-24, reporting old date as *D* 7-19-23 by *D*. Note air brakes have not been cleaned twice in nine months. Do arbitration cases 1251-1252 and 1304 apply? Does interpretation No. 2, Rule 60 apply? Would both charges be proper because of rules requiring that air brakes be cleaned once each 12 months?

Answer—The committee suggests that you accept the charge.

Question 32—*A* cleaned air on *B* car 9-29-23. *C* cleaned air on this same car 6-17-24, and reported no stenciling on car. Is the *C* repair card final evidence that *A* did not stencil the car? Can it be assumed that a car would operate more than eight months without stenciling on air brakes?

Answer—Yes.

Question 33—Is failure to show railway company initials on new wheels applied sufficient ground for demanding reduction in charge to second-hand? Rule 9 states they should be shown.

Answer—No.

Question 34—Is the application of liners between center plates on foreign cars chargeable to car owner in any one case?

Answer—No.

Question 35—What is the proper labor charge for wood truck spring shims applied at the same time metal shims are applied between arch bars, the reason for applying both being that the wood shims would not raise the car to standard height?

Answer—Material only.

Question 36—When a defect card is granted for a wrong triple valve applied, is it proper to clean air brakes and bill for it against defect card for wrong triple valve?

Answer—Yes.

Question 37—What is the proper charge for rehanging a sidedoor (one hanger) off the track when no repairs are necessary?

Answer—Four-tenths of an hour. If any other repairs are necessary they must be made. Item 144, Rule 107, Supplement 1.

Question 38—What is the proper charge when a sidedoor is replaced in the bottom door guide and no repairs are necessary?

Answer—The same as in the case of Question 37.

Question 39—When joint evidence is presented covering failure to properly stencil air brakes, what refund is proper to car owner? Should we cancel charges for retainer valve cleaned and dirt collector cleaned, as well as the cylinder and triple valve? Must we refund our entire charge on the air brakes including packing leather?

Answer—Yes.

Question 40—Rule 32 makes outlet valve cap cardable in interchange when missing. Some tank cars are equipped with a standard 5¼-in. outlet cap, and also a 2½-in. cap which screws onto the 5¼-in. cap. Would this 2½-in. cap be cardable if missing separately? Other tanks have a plug in the outlet cap. Would this plug be cardable if missing separately?

Answer—Yes.

Question 41—In order to make a packing leather leakage test on a car equipped with a weight type retainer we disconnect the retainer pipe at the exhaust port of the triple and union in order to place the gage in the triple valve. Can we make a charge against the car owner for these two pipe connections; also for the gasket when applied to the union?

Answer—No. And you must perform this service each time.

Mr. Elliott: I was just wondering if everybody would make the plug in the bottom of the outlet cap a delivering line's responsibility. I don't believe I would.

P. F. Spangler (St. L.-S. F.): I think it is a cardable defect. For a metal bound National side door for a box car the committee says $11.20. The frame cost that much from the manufacturer. What constitutes a metal bound side door? The committee says one with two longitudinal metal stiffeners and one vertical metal spark strip carries $18.75. Why don't we get $18.75 for the National side door?

Mr. Pyle: Because it does not carry the two longitudinal strips as required by the rules.

Mr. Spangler: It carries two vertical and two longitudinal, all riveted together as one solid frame.

Mr. Pyle: But they are around the frame of the door, not across the door.

Mr. Spangler: We have found short switching lines specializing on removing National side doors to replace the siding and they collect $18.75 apiece for them. They do not put any new frames on them. They just iron out the old frames and renew the battens and siding. This was on our National doors on the government box cars, two doors to the car, costing us about $37.50 a car to get the sidings and battens removed on a metal bound door.

In Question 34 about the liners: The rule says if it does not reduce the vertical bearing surfaces between the center plates. What is the vertical bearing surface between the center plates?

Mr. Fitzgerald: Whenever you place a filler between two center plates you naturally raise the top center plate out of bearing in the bottom center plate and reduce the area of the top center plate as it fits into the bottom one. It is contrary to all rules and good practices and further there are few railroads that do it.

Mr. Spangler: I believe that ought to be on the flat base center plate but not the bell shaped center plate. You can get the liner so that it does not reduce in vertical bearing surface. I do not believe it is good practice, but the rule says we can if it does not reduce the vertical bearing surface.

Mr. Fitzgerald: It must reduce it by the amount of the material you put in there to raise your car.

There is an inconsistency in the rule in connection with the side door, as written; and as the rule is written the committee could not otherwise interpret it. But the metal bound door that he refers to carries more material and is possibly worth more money than are some doors that comply with the following rule which permits of a charge of $18.00, and it should be considered and probably will be by the price committee. But under the rule it could not be otherwise interpreted.

Mr. Pyle: Every one of us makes mistakes. This question box committee is in its infancy. I don't know whether I shall be on it any longer or not. But we have tried to place an interpretation on each and every question that was asked us that we thought was fair and in accordance with our understanding of the rules.

Question 42—Owner receives car home carrying defect card reading as follows: "Two wrong framed draft timbers, two sections body truss rods missing." What is the proper charge?

Answer—Labor and material, as per Rules 101 and 107.

Question 43—Is a bent axle a delivering line defect in all cases? If so, why reference to Rule 32, in Rule 84?

Answer—Delivering lines' responsibility in all cases.

Question 44—A road removes a pair of Davis cast steel wheels on second-hand 80M axle on account of wheel L-1 having a vertical flange. It applies a pair of 33-in. cast iron wheels on second-hand 80M axle, attaching defect card to cover. The car is delivered to connection which in turn delivers to one of its connections with wheels R&L 1 slid flat 2½ in. Defect card is issued against delivering line covering one pair of slid flat wheels, R&L 1. The line receiving the car perpetuates wrong repairs by applying a pair of new 33-in. cast iron wheels on second-hand 80M axle, and delivers the car to the owner who makes standard repairs by applying a pair of new 33-in. Davis cast steel wheels on second-hand axle. Advise proper billing for each of the four lines interested.

Answer—The committee finds there are three lines interested. The first road should bill the owner for the value of second-hand wheels applied, allowing proper credit for wheels removed, as per interpretation No. 4 of Rule 98, Supplement 1, 1923 Code. The second road bills as per interpretation No. 8 to Rule 98. The owner shall bill on the road making the wrong repairs on authority of defect cards for the new or second-hand cast steel wheels applied, allowing credit for the second-hand wheels removed.

Question 45—A train pulling into the yard makes a service application to stop. One all wooden car breaks in two, all six longitudinal sills being broken at the body bolster. This damage we understand to be owner's responsibility. This car telescopes the next car, breaking in the end of the car. Who is responsible for the repairs to the second car?

Answer—The handling line. See Rule 32, item O.

Question 46—When air brakes are cleaned the second time within 60 days on the same line, and no charge can be made for it, can the charge be made for renewing parts not included in the charge as per Rule 111, item 29?

Answer—Charge for packing leather, cylinder piston and rod, non-pressure head, brake cylinder, reservoir, triple body. Charge material and labor as per note following Rule 111, item 29. Make no charge as per Rule 111, item 29. That refers to labor and material.

Question 47—Can any additional labor be charged for renewing a box lid which is broken or missing, when its box is renewed on account of being defective?

Answer—No.

Question 48—What labor should be charged for a journal box applied associated with arch bars renewed?

Answer—The same as when associated with wheels, item 222, Rule 107.

Question 49—Should a defect card for improper repairs or damage, issued at a later date than when repairs were made, or when damage occurred, bear the date of issue or the date of repairs or damage?

Answer—It should bear the date when the improper repairs were made or the damage occurred.

Question 50—Should a Bettendorf truck side be charged as per Rule 105 or 101, it being understood that these types of truck sides are manufactured by more than one company, i. e., Bettendorf and Scullin?

Answer—According to Rule 101 the new type of these truck sides manufactured by both companies are interchangeable, and are alike in all particulars, therefore they can be purchased from more than one company.

Question 51—When air brakes are cleaned as per Rule 60 and charge made as per Rule 111, item 29, and at the same time the brake cylinder, the reservoir or both are renewed, should there be any rduction on account of overlap labor from the items shown in Rule 111, for the R&R of these parts?

Answer—Yes. Deduct the detail amount of all items covered by the details of both items.

Question 52—Rule 105, Interpretation No. 1: Where the stores department has no price on a manufactured article, on account of not having it in stock, at the point of repairs, is it correct to use the price at the factory obtained from quotations furnished by the manufacturers, plus 15 per cent?

Answer—Yes.

Question 53—Would Farlow attachment draft gear missing complete with coupler come under Rule 95?

Answer—No, as it is not a friction draft gear, nor would its pocket, springs and followers.

Question 54—Item 21, Rule 101: Is the cylinder piston follower included in the charge of $4.14 as per Rule 111, item 29, when renewed because of being broken?

Answer—Yes.

Question 55—Can the work be performed as mentioned in the note following item 29 of Rule 111, when a car is on the repair tracks or in the shop when it is possible to clean and repair air brakes as per Rule 60?

Answer—Yes, but it is very poor practice, and the evident intention of the note referred to was to cover emergency cases in yards.

Question 56—What credit should be given for a triple valve body when removed on account of being broken? Do you allow any credit for the brass parts, and if so where do you get the weight?

Answer—Credit for all parts removed should be given according to weight and class of material. Obtain the actual weight of cast iron as per item 111 of Rule 111, the actual weight of brass parts as per item 162, of Rule 111.

Question 57—Should original records and repair cards show—"No other damage involved" when only minor repairs are made to safety appliances, such as running board, extension block, or bracket bolts, coupler release lever, brackets, or hand holds, where there was no other damage to car?

Answer—The original record should show this information. It will not be necessary to show it on the repair card.

Question 58—Item 144 of Rule 107 Supplement No. 1: If the original record only shows, "Side door replaced in guide brackets, permanent repairs," and does not show how permanent repairs were made, is this sufficient information to justify charge, or should original record show how permanent repairs were made such as door guide bolts applied or tightened?

Answer—The original record and billing repair card should show all the work performed. However, the statement which has been added to this item "Provided necessary permanent repairs are made to prevent recurrence," is intended to be explanatory of how the work should be performed; in other words, all repairs necessary must be made.

Question 59—Item 105A, Rule 107, column casting rivets to spring plank applied; does the labor charge of 1.6 hrs. include the labor and material of rivets, or do you charge extra as per items 439 and 440?

Answer—Charge as item 105A; i. e., 1.6 hrs. cover all labor, including the labor of applying rivets. If weight of wrought rivets amounts to more than ½ lb. weight may be charged.

Question 60—Item 18 of Rule 107: Can you charge for jacking up the car when an arch bar tie strap is applied, nuts only R. & R.?

Answer—The charge of 1.1 hours covers the R. & R. of nuts only, and when it is necessary to jack the car it may be charged additional. It will usually not be necessary to jack a car, but under some conditions if car is loaded it may be.

Mr. Pyle: I have 42 other questions that are unanswered for the want of time.

Mr. Jamison: Last year we had a similar condition to this and the association gave us the privilege of answering those questions following the meeting and they were published as an appendix to the proceedings.

H. J. Smith (D., L. & W.): I move that we incorporate the unanswered questions, so that all those receiving copies of the minutes will have the benefit of the late answers.

(*The motion was seconded and carried.*)

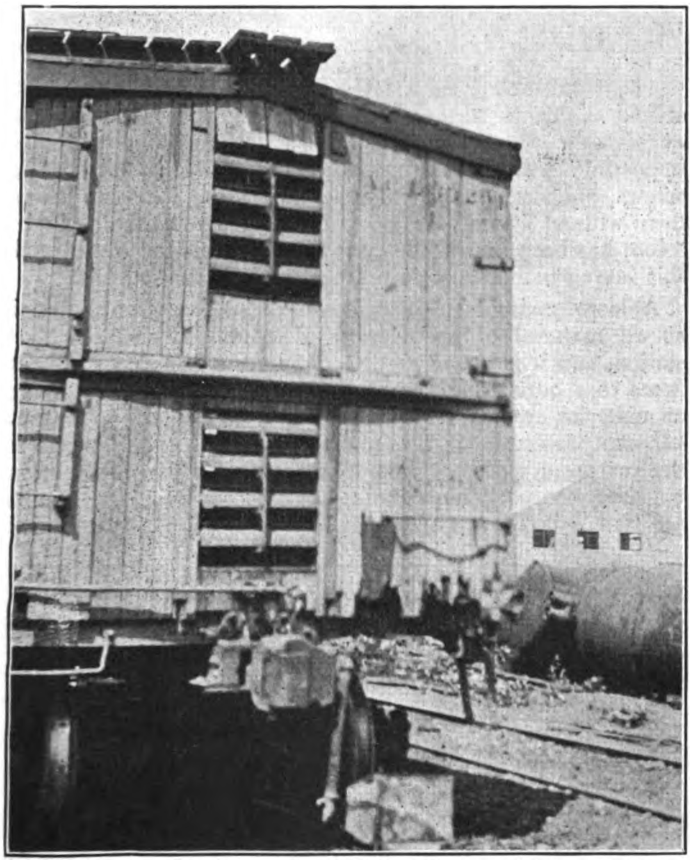
Mr. Armstrong: I think all of us appreciate the fact of the enormous amount of work which this committee has performed and while we have been recreating they have been laboring. I move you we extend to this committee a rising vote of thanks for their work.

(*The motion was carried.*)

A. C. L. Rebuilds Ventilated Box Car in 6$^1/_2$ Hours

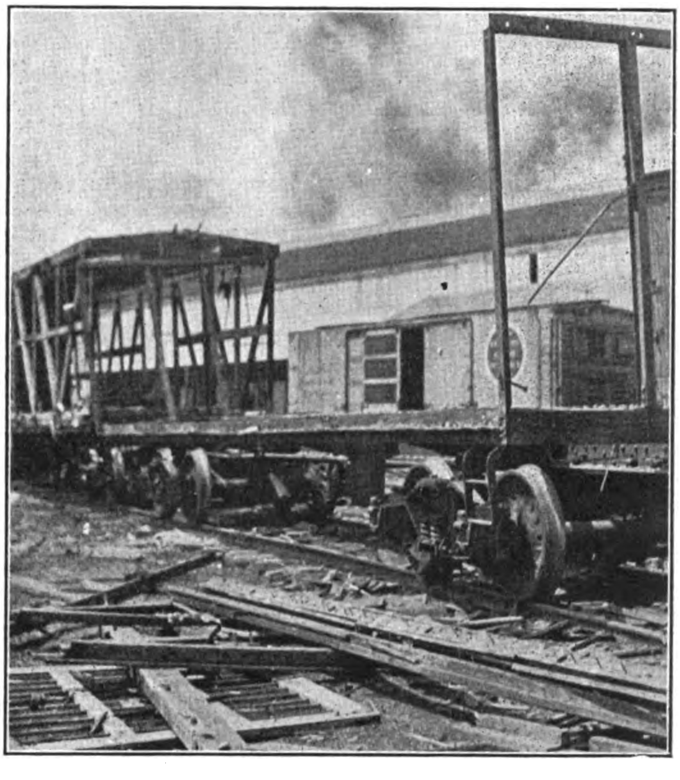
Entire Car Completely Overhauled and Ready for Service in a Total Time of 64¼ Man Hours

SEVERAL months ago the straight line or station to station method of repairing or rebuilding cars was inaugurated at Emerson shops of the Atlantic Coast Line. This method was entirely practicable, due to the fact that there were a large number of cars of virtually the same design requiring rebuilding. Very recently considerable comment has originated on account of time records which have been made in the rebuilding of some particular car. Believing that the station to station method of rebuilding cars is much superior to the other methods which have been in use in the past, and which are still employed at a great many shops, it was decided to attempt to completely overhaul a car during an eight-hour working day using the station to station method of repairs.



The Bent End Sill and Broken Sheathing Indicate Something of the General Condition of the Car Before It Was Repaired

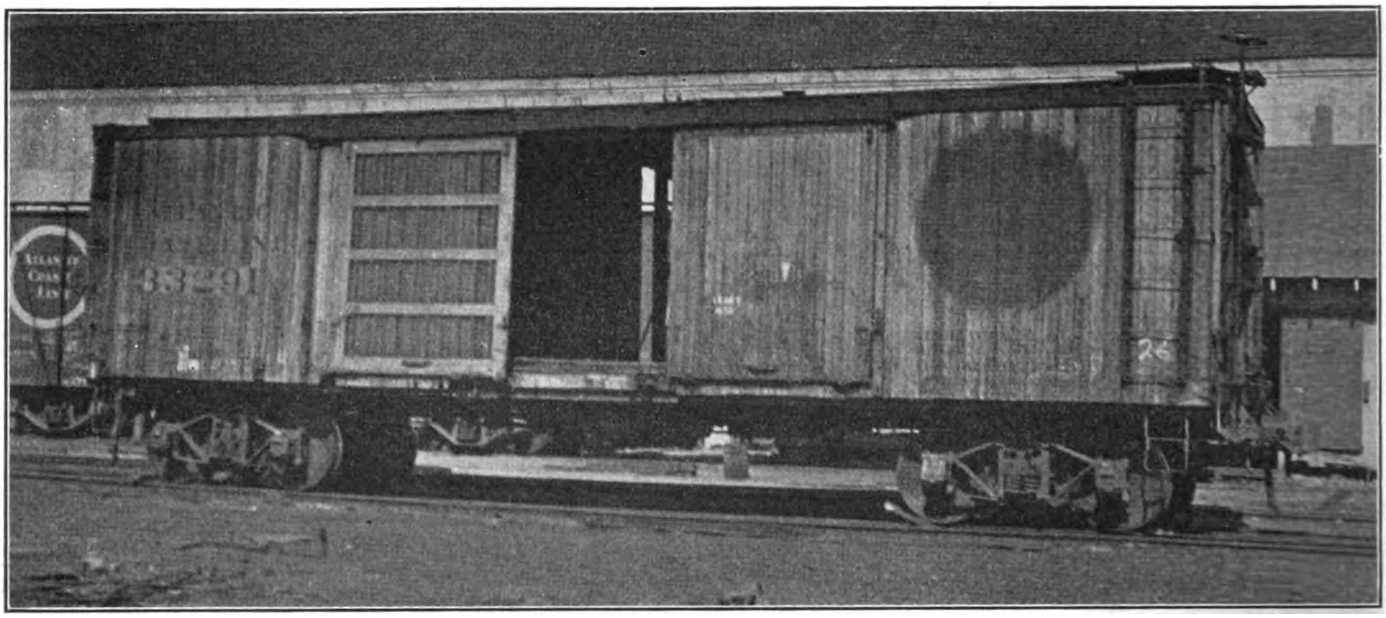
A. C. L. 33291, which is a double felt-lined, ventilated, 60,000-lb. capacity box car, was selected as the car to be rebuilt. Promptly at 7 a. m. on August 7, 1924, the work of dismantling this car was started. All wood was removed, leaving the steel underframe and trucks. The steel underframe, which required the renewal and reinforcement of two steel ends, was repaired; the trucks, draft gear and air brake were completely overhauled, and the wood superstructure was rebuilt new complete. The entire task of dismantling the car, repairing the steel underframe, trucks, draft gear, and air brake, as well as the application of the wood body, including a priming coat of paint, was completed at 11:52 a. m., a total working period of 4 hr. 52 min., or a total of 61¼ man-hours.



At 8:00 A. M. the Superstructure Was Completely Dismantled

A second coat of paint was applied, the car lettered, weighed light and ready for service at 2 p. m., a total working period of 6 hr. 30 min. and a total man-hour expenditure of 64 hr. 14 min.

The various operations and time required for each were as follows:



Condition of the Car at 7:00 A. M. Before Dismantling Was Begun

Operation	No. Men	Min. Each	Applied Man-Hours Hr.	Applied Man-Hours Min.
7:00–8:00 a. m.:				
Dismantle car; all wood parts removed	..	..	7	40
8:00–8:40 a. m.:				
Repair steel underframe, overhaul trucks and draft gear*	..	..	9	40
8:40–10:15 a. m.—Apply wood framing to car:				
Side nailing sills	2	25	0	50
Nail sills and sub floor	6	70	7	0
Decking	4	24	1	36
Side and end plates and roof carlines	4	50	3	20
Corner post fillers and end frame fillers	4	35	2	20
End vents	2	15	0	30
Side braces	2	18	0	36
Body rods	4	27	1	48
Belt rail and belt rail fillers	6	20	2	0
Roof purlines	2	15	0	30
Total			20	30
10:15–11:52 a. m.—Finished car applications:				
Siding	8	40	5	20
Lining	5	40	3	20
Roof sheathing	2	27	0	54
Door tracks	2	32	1	4
End tie plates, push poles and corner bands	2	35	1	10
Fascia boards	3	10	0	30
Murphy XLA roof running board extensions	4	39	2	36
Safety appliances side door guides, stops, brake stops and uncoupling levers	8	35	4	40
Brake rods	1	6	0	6
Overhead lining	4	29	1	56
Air brakes and re-pipe	3	36	1	48
Total			23	24
11:52 a. m.–2:00 p. m.:				
Apply second coat of paint, letter and stencil car	..	..	3	0

* Repairs to underframe included 2 steel end frames, 2 new body center plates, 1 new end sill, 1 new diagonal brace, 4 steps removed and riveted back to position and 4 grab irons removed and riveted back to position.

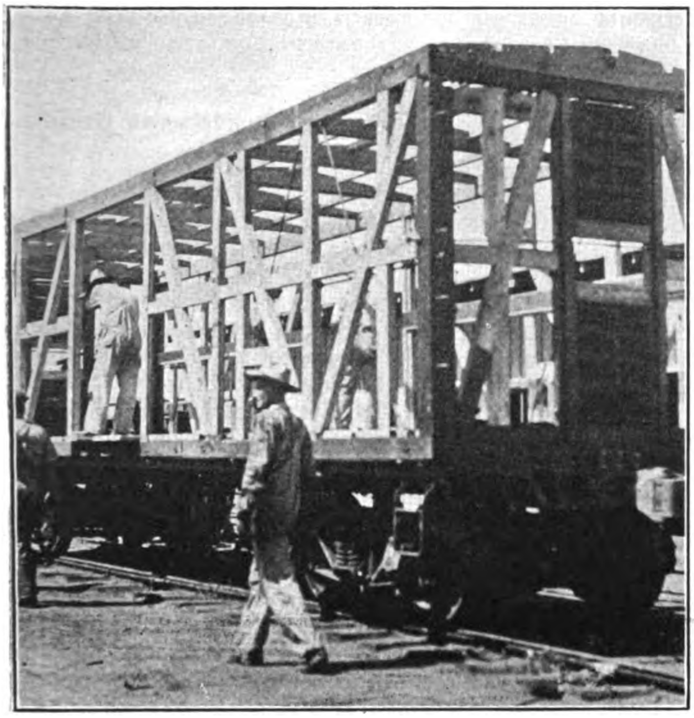
The results obtained clearly demonstrated the advantage of the station to station system of rebuilding. This system allows a concentration of material at certain points which is impossible when other methods are in use. Bolts, nuts, screws, etc., are placed in racks where the men can reach them without leaving the job. A saving in time which heretofore has been impossible even to measure is the result, and this saving is immediately reflected in increased output.

A large saving also is made in the delivery of material as all material of one class is delivered to one place or station, and it is not necessary to deliver a hundred different items to a hundred different places. Delays due to waiting on material are also eliminated and a large gain in output per man is secured in this manner. A further advantage is the increased efficiency due to the training the men get in applying one particular part to the car. In fact, the results are that a body of experts build the car with a speed and

The Job Was Completed at 2:00 P. M.

uniformity of work turned out impossible under any other system. Another advantage is the large increase of work turned out on a given amount of track space; in fact, if the station to station method is adopted, the output can be nearly doubled with the same track facilities.

When cars are rebuilt out-of-doors, it permits the priming of car siding immediately after application, whereby a large saving can be made as it has been found that a great many times new siding has to be replaced because of the fact that the wood gets wet before the application of a prime coat of paint.



At 10:15 A. M. the Body Frame Had Been Rebuilt

The greatest saving of all, however, is in the decreased length of time equipment is held out of service for repairs. Under older methods, equipment was out of service from 20 to 40 days, even after it had been placed on shop tracks for repairs. When station to station methods are used, cars can be scheduled through the shop in any definite period, which, including painting, should not exceed 10 days.

Rebuilding Narrow Gage Cars

By Lucas Dreith

Repair Track Foreman, Denver & Rio Grande Western, Alamosa, Colo.

THE rebuilding of freight car equipment in a minimum number of hours per car has for some time been claiming the attention of car department officers, and good results have been obtained by using the competitive gang method. The Denver & Rio Grande Western has recently completed at its Alamosa shops 100 narrow gage box cars of 50,000 lb. capacity. The operations were divided into groups and it took nine different groups to finish one car. The men working on each group of operations were specialists on the particular repair job which they performed. The cars were all dismantled before the various operations were started and were rebuilt on an open repair track to which all material was delivered by helpers. The cars were not moved from one operation to another and no special provisions were made for additional or extra facilities.

The following table shows the various operations and the average time of completing each:

Operation	Work performed	Man-hours per operation
1	Trucks	3½
2	Underframe	16
3	Post braces and plates	14
4	Decking, lining, grain strips	7
5	Siding and facing	5
6	Roof sheathing and roof	4½
7	Doors, safety appliances, corner irons	16
8	Brake rigging and air pipe work	13½
9	Painting and stenciling	2¼
	Total man-hours to complete one car	81¾

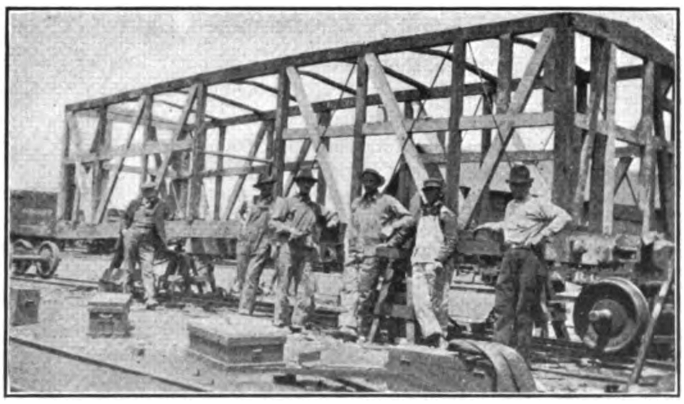
Narrow Gage Box Car Rebuilt in 81¾ Man-Hours

Material Required for Each Car

The frame work of the car was constructed from Oregon pine and oak. Each car required the following timbers:

No. of pieces	Name of timber	Size of each	
2	Side sills	5 in. by 9 in.	
2	Center sills	5 in. by 9 in.	(A. R. A. standard oak splice at end)
2	Intermediate sills	4 in. by 7 in.	
2	End sills	6 in. by 11 in.	

The upper frame required 20 posts and 16 braces, with side plates 4 in. by 6 in., end plates 3 in. by 11 in., and seven metal roof carlings. The siding, sheathing and lining consisted of ⅞-in. by 3¼-in. hard pine boards. The flooring was made from 1¾-in. by 7¼-in. Oregon pine. The roof and sheathing was covered with an outside metal XLA roof. Each car required 47 bolts, 16 rivets, 4,868 nails, 732 30-penny spikes and 134 screws.



Frame of Narrow Gage Box Car Rebuilt in 30 Man-Hours

THE MISSOURI-KANSAS-TEXAS so far this year has established a record of an average of 872,634 passenger car miles for every delay on account of hot boxes, compared with 465,873 passenger car miles during 1923. This mileage has been made notwithstanding the fact that the main line cars run between San Antonio and St. Louis make an average of 15,000 car miles a month or an average of about 100,000 car miles between the changing of packing and the inspection of journal bearings.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Failure to Stencil Air Brakes Properly

The air brakes under Mobile & Ohio coal car No. 10441 were cleaned by the Illinois Central at Burnside, Ill., January 14, 1922. The brakes were due for cleaning according to the old date stenciled on the car which was 2-28-21, Mobile & Ohio. The air brakes were again cleaned by the Chicago & North Western, June 30, 1922, on account of the triple valve being dirty and because there was no date or initials stenciled on the cylinder or auxiliary reservoir. The owner claimed that the Illinois Central had failed to apply the proper stenciling at the time it performed the work, which resulted in the brakes being cleaned a second time by the Chicago & North Western and therefore, the owner should not be penalized to the extent of refunding the $5.14 charged against the car. The Illinois Central contended that inasmuch as the Chicago & North Western repair card showed that the triple valve was dirty and needed to be cleaned, the owners should be held responsible. It also contended that the repair card did not show conclusively that this work had been performed on account of the stenciling being omitted.

It was decided by the Arbitration Committee that Interpretation 3 of Rule 60 covered the case, and that the Illinois Central should furnish offset authority for the amount of its charges for cleaning the air brakes on the car in question.—*Case No.* 1304, *Mobile & Ohio vs. Illinois Central.*

Responsibility for Damaged Car

On August 6, 1921, the Union Oil Company loaded its car No. UOCX 627 with fuel oil at its Oleum Refinery, which was consigned to the Pratt-Low Preserving Company, Modesto, California. The car returned to the Oleum Refinery August 13, with the outlet pipe broken off. On reporting the matter to the Southern Pacific agent, instructions were issued that the car be taken to the Oakland shops for repairs. After the car arrived at the shops, the handling line ordered from the car owner an outlet pipe. This the owner was unable to supply because the car was an old one with an elliptical outlet connection. Therefore, the owner requested the Southern Pacific to cancel its requisition for the material and return the car to the Oleum shops, where the necessary repairs were made. After the work had been completed, the car owner billed the Southern Pacific for the amount of $74.63 which covered the cost of repairing and putting the car in service. An investigation by the Union Oil Company developed the fact that the car had been pulled from the siding of the Pratt-Low Company while being connected before the car was entirely unloaded. It claimed that the Southern Pacific was negligent in not ascertaining whether the car was disconnected before sending its locomotive on the private spur to pull loads or empties. The car owner further claimed that when the Southern Pacific requested that the car be sent to the Oakland shops for repairs, it admitted responsibility. The Southern Pacific in its statement admitted sending the car to the Oakland shops and placing an order with the owners for material, but maintained that these facts in themselves do not fix the responsibility on the handling line for the damage to the car. It submitted a statement tracing the movement of the car from August 6 to November 25 inclusive to subtsantiate its claim, that the car had not been damaged at Modesto.

It was decided by the Arbitration Committee that the Southern Pacific Company was responsible for the damage to the car, due to moving it before it was disconnected from the pump line, but that the charge should not exceed what it would have been for repairs in kind.—*Case No.* 1306, *Union Oil Company of California vs. Southern Pacific.*

Specific Joint Evidence Not Conclusive as to General Conditions

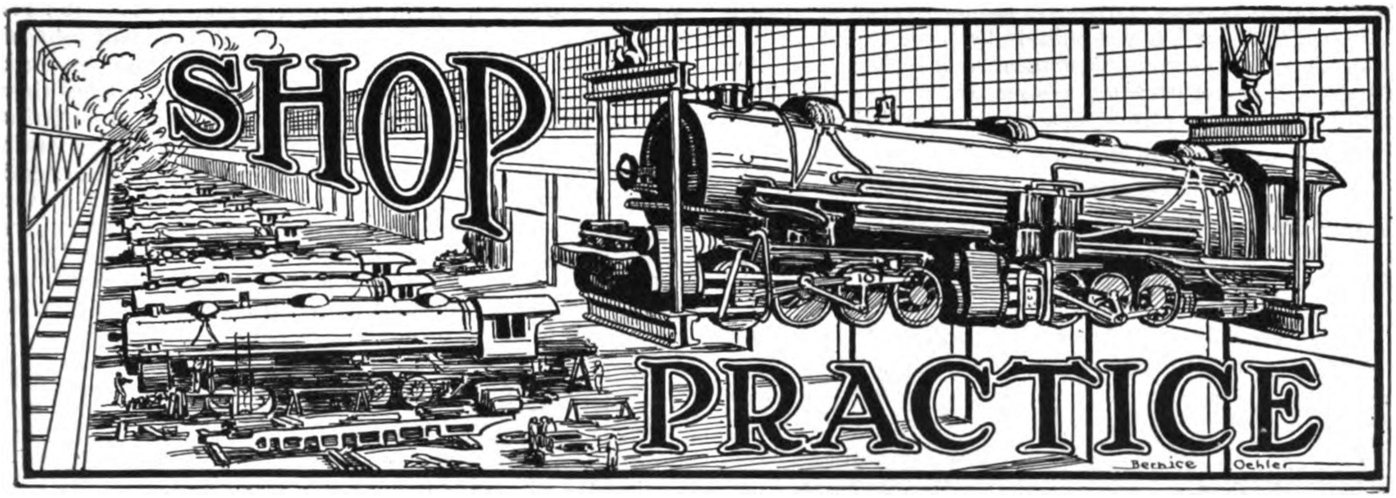
During the period of September 1, 1920, to December 31, 1921, the Texas & Pacific rendered monthly bills against the Illinois Central to cover the cost of repacking journal boxes on Illinois Central freight cars as outlined in Rule 66. Four of these bills, amounting to approximately $900 remained unpaid as the Illinois Central refused to honor them, alleging that all of the entries appearing in the bills from Gouldsboro and Westwego, La., represented charges for work that was not performed, and further demanded that the Texas & Pacific refund all money paid in previous bills covering the work from these two repair points. The Texas & Pacific claimed that it was within its rights in insisting on payment of the bills as well as in refusing to make a refund to the Illinois Central, claiming further that the bills were in accordance with A. R. A. Rule 66, and that the work was properly performed. The Illinois Central based its claims on joint evidence cards secured at New Orleans which indicated that none of the work itemized in the Texas & Pacific bills was performed at the two points in question. Repair cards from other lines were submitted showing subsequent repacking of cars billed for by the Texas & Pacific. Furthermore an investigation by the owner was said to indicate that neither enough labor nor facilities was available nor was enough oil purchased to repack the number of cars billed for.

The Arbitration Committee decided that decisions 1017, 1018, 1057, 1080, 1088, 1108, 1130, 1233 and 1289 have a general application, and that the bills should have been passed for payment subject to proper adjustment of the individual cases of wrong car reference and other admitted errors.—*Case No.* 1309, *Texas & Pacific vs. Illinois Central.*

Responsibility for Pulling Out Draft Gear

The Canadian National in making up Extra No. 3368 at Fitzpatrick, Que., November 16, 1922, coupled onto seven or eight flat cars, and when moving out of the yard, the coupler and draft gear on the west end of Temiskaming & Northern Ontario car No. 100,041, pulled out, which it is claimed by the handling road, resulted in damaging the end sills and forcing out the side sills. The Canadian National disclaimed responsibility for the defects and reported the car to the owners under Rule 120 on December 1, 1922, stating that neither this nor any other car was derailed, cornered, side-swiped or subjected to any other condition prescribed in the A. R. A. rules as handling line's responsibility. The owner refused to agree with the handling line, basing its claim on the fact that the throttle of the switching engine would, at irregular intervals, fly open unexpectedly which resulted in irregular switching.

The Arbitration Committee decided that there was no conclusive evidence of the car being subjected to any unfair conditions as covered by Rule 32, and therefore, the damage of the car was at owner's responsibility.—*Case No.* 1311, *Canada National vs. Temiskaming & Northern Ontario.*



Reducing the Time of Handling Driving Boxes*

Practical Fixtures, Jigs and Tools Devised to Save Time and Labor—Grouping of Machinery Important Factor

By E. Marx

General Foreman, Winona Shops, Chicago & North Western

THERE are five principal factors to be considered in the repairs to driving boxes.

First—A good organization.

Second—All lost motion in conveying work from one machine to another or from one department to another should be eliminated.

Third—The proper speed and feed should be carefully determined for each machine.

Fourth—The use of special tools and jigs should be worked out to the best advantage.

Fifth—Grouping of machinery and crane facilities is

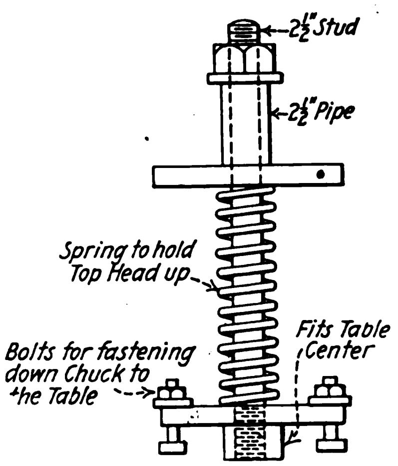


Fig. 1—Chuck for Clamping Crown Brasses on the Boring Mill While Grooving Them for Shoulders

considered one of the most important factors in the handling of driving box work.

The first step is to perfect your organization. Get good men for this class of work and keep them interested in it. Only when you have done this will you secure satisfactory results. A system should be established for handling the work from one machine to another. Keep regular men on the machines as much as is possible and always have

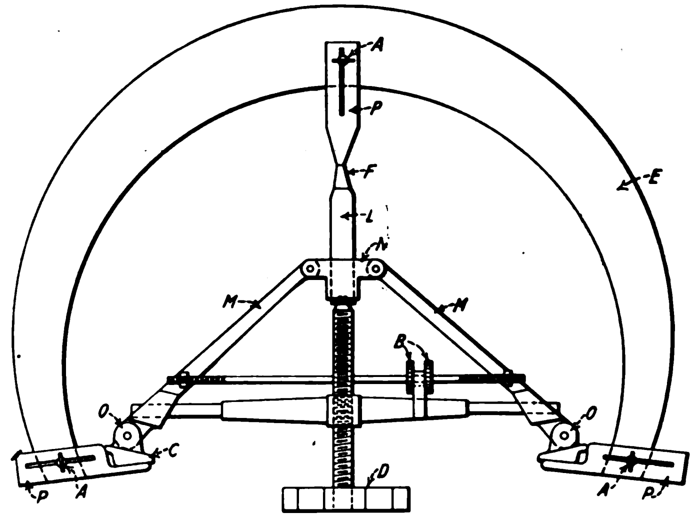


Fig. 2—Calliper and Gage for Laying Out the Shoulder Pit on the Driving Box Brasses

one or two other men trained to step in and take the machines in case the necessity arises. If a regular man cannot be kept at a machine continuously, at any rate use the same man on it so that he becomes proficient at that particular class of work.

The principal item taken into consideration in the layout at Winona Shops is the grouping of machines and crane facilities. The crane facilities make the handling of work convenient and extremely expeditious, eliminating all truck-

* Selected as the second best paper submitted in the driving box competition which was announced in the February *Railway Mechanical Engineer*. The paper awarded the prize was published in the September issue of this magazine.

ing as far as possible. After the boxes arrive in the driving box gang they are handled entirely by crane facilities except when it is necessary to send them to the blacksmith shop or some other department for some unusual repairs. Then they are moved on a truck or a two-wheeled wagon.

Route of Driving Boxes from Erecting Shop to Box Gang

When the wheels are removed from under the locomotives the boxes are taken from the journals and the grease or oil

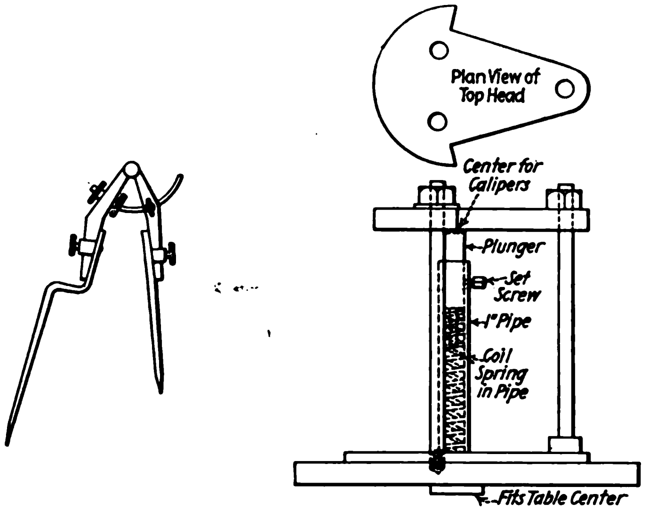


Fig. 3—Chuck for Clamping Brass on the Slotter and Offset Calipers Made to Clear the Bolt and Nuts of the Chuck

waste removed from the cellars. The waste is sent to the renovating plant and the grease is placed in carbide cans. It is used over again on switch engines and also as a filler on road engines in the bottom of the cellars. On top of this, next to the journal, is placed about an inch of new grease. By this time the engine has been removed from the side. It will also be noted that there is a crane near the lye vat, with which the loaded tray is handled in and out of the vat. After the boxes have been cleaned they are brought in over the same route to the driving box gang, where they are placed near the slotter and planer. From this point they are handled entirely with air hoists suspended from overhead cranes or trolley rails in their course to the several machines. Immediately after the boxes are unloaded at the driving box gang they are inspected. If new brasses are required the foreman orders the material from the store house and has it placed at the proper machines. If the brasses are found tight and thick enough they are not disturbed, but if the boxes are out of parallel they are put on

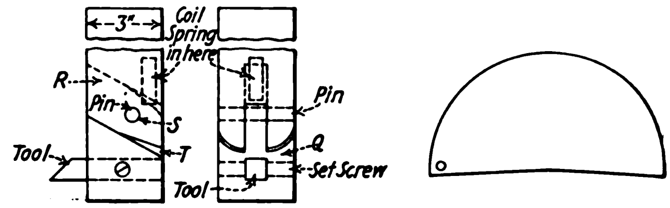
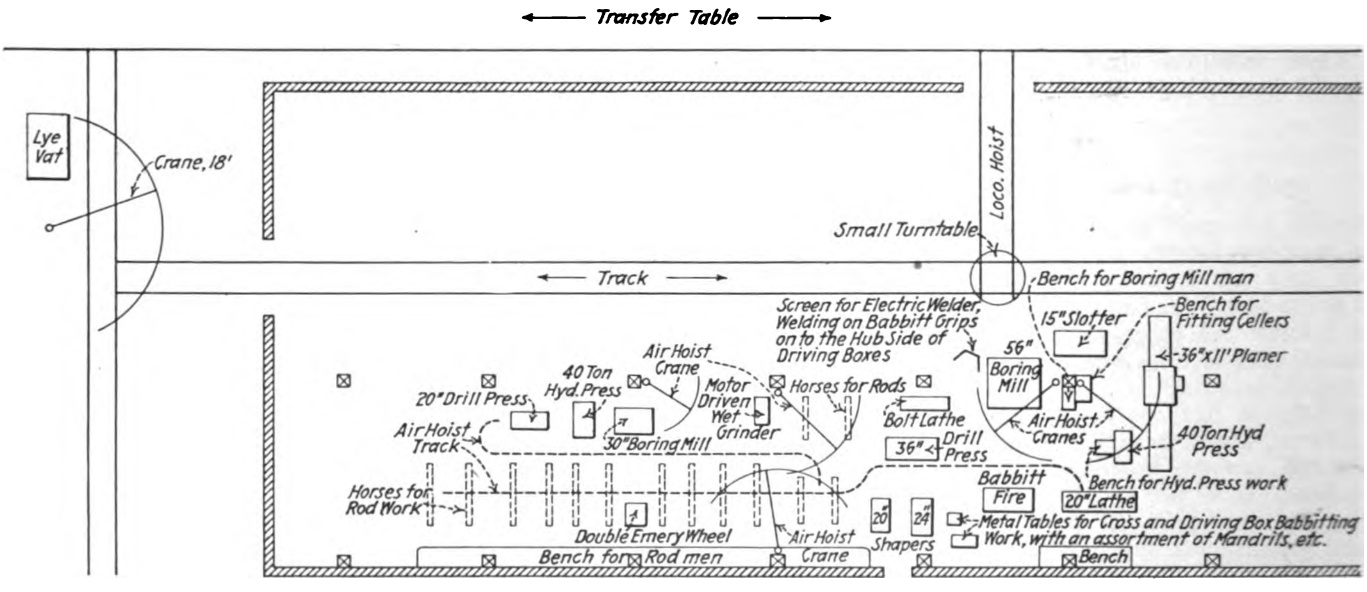


Fig. 4—Slotter Tool Holder and Template Used in Centering the Brasses on the Slotter Table

the planer for machining. The cellars are refitted in the meantime.

Applying New Brasses

If it is found necessary to apply a full set of new driving box brasses, the babbitt is knocked off of the boxes and they are then placed on the hydraulic press where the brasses are removed. The new brasses are placed on the boring mill and grooved for the shoulder. A special chuck is used to facilitate this operation. The brasses are then placed at the slotter where they are grooved for the box fit, after which they are ready to be pressed in. Special tools are provided and used by the man on the slotter. As soon as the brasses have been pressed in the cellars are fitted to the boxes and



Shop Layout of the Driving Box Department Showing Location of Machines and Route the Boxes Travel

locomotive hoist pit to its assigned stall. A wagon with a large tray is pushed in the shop and the boxes with other parts are loaded onto it and conveyed, via the transfer table, to the lye vat, which is located near one end of the shop, as will be seen by referring to the illustration showing the layout. This work is done by a labor gang on the erecting

if found to be loose in the fit, a small liner, from 1/16 in. to 3/16 in. thick, depending on the amount of play, and 2 in. wide is riveted or tap screwed to the side of the cellar. A few strokes with a square file will then insure a good fit. Time is well spent in the close fitting of cellars.

During the time the brasses and cellars are being fitted

the saddle pockets are squared up. A small piece of front end wire netting, 1½ in. by 4 in., is electrically welded to the hub face of each box for holding on the babbitt. After the brasses and cellars are fitted it is not necessary to hold up the shoe and wedge man in waiting for the boxes to be planed in order that he may get the box sizes for laying out the shoes and wedges, as they can be taken at once, and if necessary, an allowance made for planing off the least possible amount of material. After the boxes are planed they go to the babbitt fire to be babbitted, and then they are ready for boring. A 42-in. double head Niles-Bement-Pond electrically driven boring mill with a table speed of 65 r.p.m.

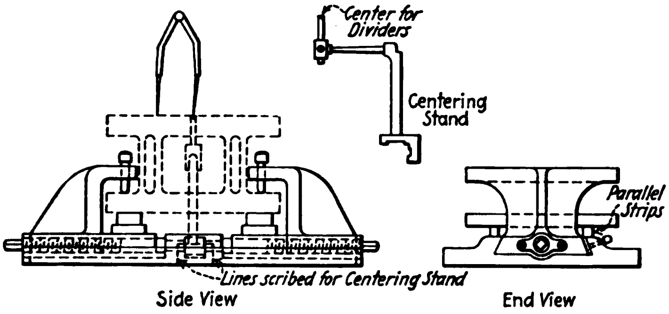


Fig. 5—Boring Mill Chuck for Holding Driving Boxes

is used for this work. This machine is fitted up with a special chuck, the jaws of which engage the parallel shoe and wedge face and clamp the box centrally on the mill. While the box is being bored for the journal fit the lateral is faced simultaneously with a tool in the other head of the boring mill.

Fitting Boxes on the Journals

The boxes are next taken to the locomotive wheels to be fitted to the journals. Suitable cranes or air hoists should be installed to handle the wheels where this work is done. To handle boxes onto the journals two benches, each of different height, to suit the different sizes of drivers, should be used, also a roller or short piece of pipe, and a small bar. In fitting driving boxes to the journals the foreman in charge should see to it that the men are properly instructed in this work. The boxes should not be fitted too large for the journal and the sides should not be chipped or filed away so as to bring the center line of the brass above the center line of the journal.

In removing the cellars from the boxes they invariably are found to be tight and cannot be knocked out of the box with the use of a flatter and sledge. A very good device in a case of this kind is to use a cross bar long enough to pass through the wheel spokes. For the larger cellars a U-shaped forging of sufficient depth and width and a short jack can be used to advantage. This arrangement will readily force a cellar from any box.

Our road has a large number of locomotives equipped with the Markle removable hub plates. This improvement is a great time saver, making a small job out of the task of taking up lateral. To take up lateral with this device the old plate is removed and rebabbitted, or replaced with one kept on hand in the enginehouse. Standard jigs have been made for the various styles of boxes and the lateral plates are all planed to the standard box they are intended for in order that they may be interchangeable.

We also have a number of locomotives equipped with the Markle removable brass. This brass, permitting its removal without the usual dropping of the wheels, makes it a big time saver. The brass is held in place by a taper key, which is inserted by hand and driven home the last 1½-in. All parts of the box are machined to special jigs, which insure a perfect interchange and extreme accuracy in maintaining standard sizes. Aside from the removable features, there is the use of the key for tightening the brass in the box. Boxes equipped with this brass are also equipped with a two piece removable hub plate. With this arrangement the lateral can be taken up readily. A special jig has been developed for machining this brass.

Description of the Tools

A chuck for clamping a brass on the boring mill while grooving it for the shoulder is shown in Fig. 1. The brass is held between the top and the bottom heads by screwing down the nut at the top. Different lengths of 2½-in. pipe nipples are used for the different lengths of brass, but only when a great variation in lengths of the brasses is encountered.

A caliper and gage for laying out the shoulder fit on the driving box brasses preparatory to slotting is shown in Fig. 2. This is flexible and capable of three independent adjustments. The two contact points *C* are 4 in. long. The stem *L* is ½ in. in diameter, to which is soldered a contact bar *F*. It is also 4 in. long, and bears against the top of the brass fit in the box. A 1/16-in. key-way is cut the entire length of the bar *L* and a feather with gib heads is fitted in the hub portion of *N* to keep the contact bar in its proper position. The calipers are adjusted by means of the thumb wheels *B* and the hand wheel *D*. When the calipers are inserted in the box and adjusted to size, the gage *E*, which is shown superimposed, is set to the calipers at the three points, *C*, *C*, and *F*, the sliding clips *P* being adjusted to the bevel of the toe of the brass and clamped by the thumb screws *A*. The gage *E* is then removed and laid on the brass and the necessary lines scribed. The offset dividers,

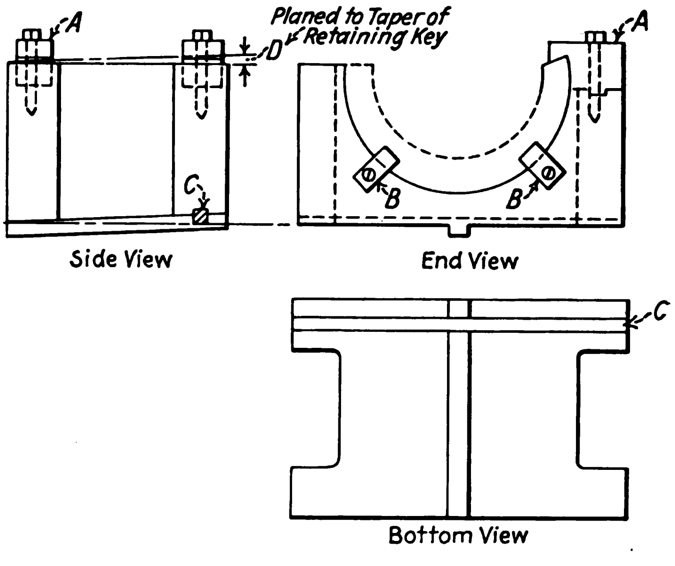


Fig. 6—Chuck for Holding the Markle Removable Crown Brasses When Cutting the Taper for the Retaining Key

shown in Fig. 3 are used for scribing the outer contour to which the brass is to be slotted.

A very simple chuck for clamping down the brass on the slotter table is shown in Fig. 3. The 1-in. pipe with the spring and plunger merely serves the purpose of holding the top head up when not in use. It also serves as a center for the dividers in scribing the brass.

Fig. 4 shows a slotter tool post which is made in two parts, the upper piece *R* having a slot in its lower end, into which fits a tongue on the lower piece *Q*. It is pivoted about the pin *S*. The shoulder of the slot is slightly relieved at *T* to allow the tool to swing back on the return or upward stroke.

A sheet steel template, shown in Fig. 4, is used in centering

the brass on the slotter table. The slotter man has an assortment of these made to conform with the various sizes of brasses as shown on the blue prints. He takes one of the templates and tries it in the box to see how much it is spread. He then lays the template on the rough brass and scribes around it, allowing, by eye, for the amount the box was found to be spread. This operation merely serves to facilitate the centering and setting up of the work. He now calipers the box, and finishes the brass with one cut. While the cut is being taken he takes the inside calipers, and inserts them in the box and adjusts them so they can just be slid up and down. The brass fit in the box always tapers slightly, because the tool crowds away from the work. By sliding the calipers up and down the largest end is found and the calipers adjusted. When the clips of the gage are adjusted they give the angle of the retaining shoulders, which may be transferred directly to the finished brass and scribed thereon.

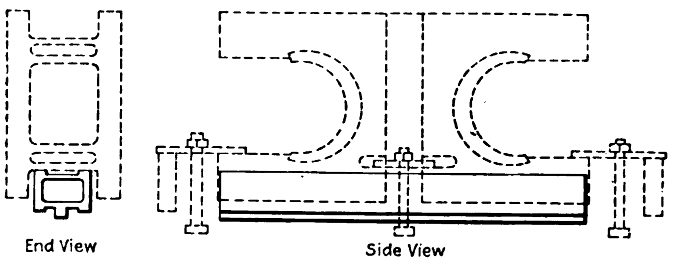


Fig. 7—Parallels for Planing Driving Boxes

A boring mill chuck for boring driving boxes is illustrated in Fig. 5. It will be noted that it centers the box one way so there is no work on that part. A stand is used for centering the box in the other direction. The stand is merely to provide a center for the dividers while trying the brass for the center at the crown. The dotted lines show the box in outline to make clear the application of the chuck.

A chuck designed for planing the lengthwise taper for the retaining key of the one side of the Markle removable brass is shown in Fig. 6. The brass is first slotted on the outside the same as an ordinary brass. It is then placed in the chuck and secured fast by the two clips *A*, which are made to fit the side of an ordinary brass. The two clips *B* are provided on the end of the chuck to prevent the brass from sliding when a cut is being taken. The taper is obtained by slotting the chuck on the bottom near the one end and inserting a strip of the right thickness to give the required taper, as shown at *C*. The one side of the chuck is also planed to the same taper as indication at *D* which is done in order not to interfere with the planing of the brass. If this were not done the chuck would be higher at one end than at the other when it was tilted on the strip *C*. As many of these chucks are needed as there are sizes of brasses, but at the present time a study is being made to see if we can use one chuck for all sizes, either by using liners or in some other way, possibly by adjustment.

To save the time spent in setting up the driving boxes on the planer platen preparatory to planing, we have had some castings made as shown in Fig. 7, 38 in. long, which will hold two boxes. They are planed small enough so that the shoe and wedge fit of the smallest box will straddle them without resting on the fillets. These castings are nothing more than parallels. Several of them are provided so that as many boxes may be planed as the planer platen will accommodate. When either new or old boxes are to be planed we set them up in two rows on the platen and use both planer heads. Each head is provided with a tool post that takes two cutting tools. In this way we plane four flange surfaces of the shoe and wedge fit simultaneously. The planer platen travels at the rate of 45 ft. per minute cutting and 150 ft. on the return stroke.

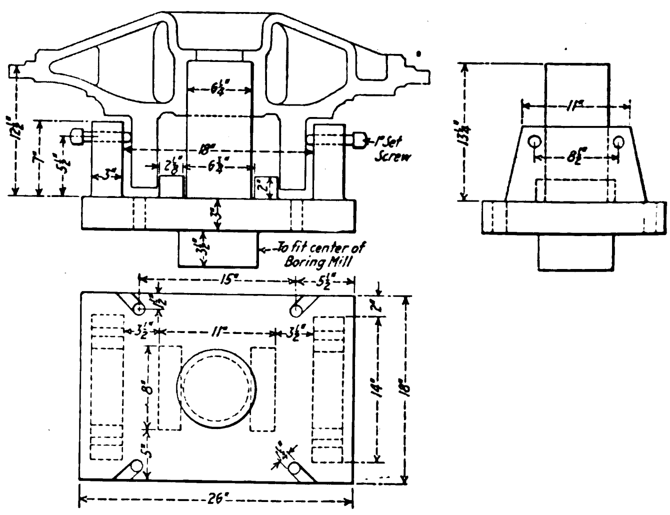
We have two steady men working on driving boxes. One man who slots the brasses, presses them in the boxes and does all the other work pertaining thereto. He also inspects the boxes when they come from the lye vat. The other man fits up the cellars and saddles and any other work in connection with these parts. He knocks off the old babbitt from the boxes and presses out old brasses, refits hub liners, etc. The planer and boring mill men do only the necessary machining and all other machine work about the shop. With this organization we have turned out as high as 1,100 boxes per year. Some months we turned out 124 boxes per 25-day month, which means an average of about five boxes per eight-hour day.

Jig for Boring Low Pressure Cylinder Heads

By J. H. Hahn

Machine Shop Foreman, Norfolk & Western, Portsmouth Shops, Ohio

THE illustration shows a fixture for holding low pressure cylinder heads for Mallet engines, in a boring mill while being finished on the face and in the recess that takes the boss on the low pressure piston centers. The general practice is to take about 12 of these heads, bore and face them for the stuffing box glands and then put this fixture on the boring mill. It is centered in the bushing in the center of the boring mill table, and a guide on the fixture which is finished to fit the gland recess centers the heads, so that no time is lost on the set-up. The cylinder head is held by four one-inch set screws which are placed at an angle of about 15 deg. so that when they are tightened they will pull the head down solid.



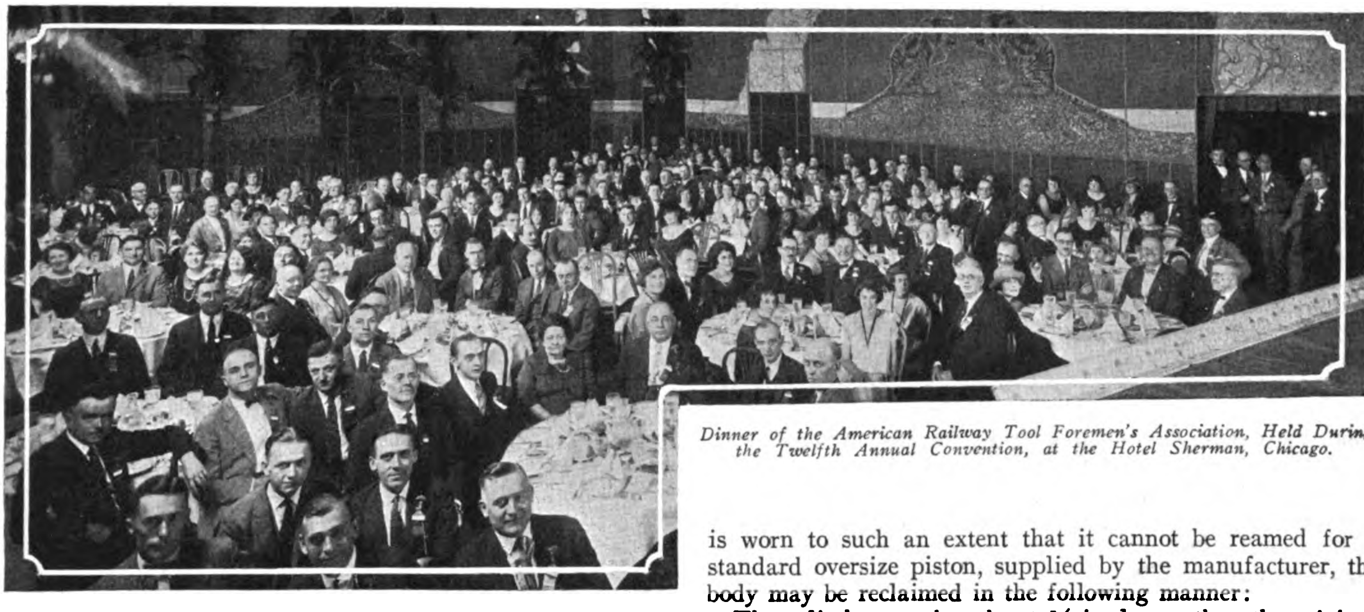
One Hour's Time Can Be Saved by Using This Fixture When Boring Back Low Pressure Cylinder Heads

As the recess in these heads has to be finished, it is impossible to use a fixture of the usual design with a clamp on the top. This fixture has saved 45 minutes to 1½ hours on the total time for machining one of these heads. A copper joint is also put on the heads and faced while on the fixture.

By a slight change in design, this fixture can be used for any type of back cylinder heads.

Additional Papers Discussed by Tool Foremen

Maintenance of Pneumatic Tools and Wrench Standards Were Considered at Chicago Convention



Dinner of the American Railway Tool Foremen's Association, Held During the Twelfth Annual Convention, at the Hotel Sherman, Chicago.

A PARTIAL report of the twelfth annual convention of the American Railway Tool Foremen's Association, recently held in Chicago, was given in the October *Railway Mechanical Engineer* beginning on page 621. One of the subjects discussed, and not included in the initial convention report, was that of the proper methods of repairing and maintaining pneumatic tools, than which almost no problem confronting tool foremen is more important. The subject of standard open end wrenches for locomotive shop and enginehouse use was also discussed and certain standards agreed upon.

Repair and Maintenance of Pneumatic Tools

By E. A. Hildebrandt

Tool Foreman, Cleveland, Cincinnati, Chicago & St. Louis, Beach Grove, Ind.

Air motors are one of the most essential, as well as one of the most abused machines in railroad shops. They are used under all sorts of conditions, in all kinds of weather. They are thrown on the ground, allowed to get dirty, connected to air hose that has not been first blown out, thoughtlessly struck with hammers, and a great many times used with tools that are too dull to cut freely.

Rusty air lines are one of the worst conditions to contend with, and unless operators blow out the air lines before connecting with motors, damage may be done which will greatly impair the efficiency of the machines. Rust in the valves of the motors causes them to score which not only cuts down the power but also runs up the repair expense. This can be partially eliminated by making sure that the air strainer is in every live air handle and that when strainers need cleaning they are cleaned and replaced and not punched out as so often happens.

When cylinders are dented or worn due to causes as outlined, it is necessary that the dents be scraped or the cylinders reamed and oversize pistons applied. When a cylinder is worn to such an extent that it cannot be reamed for a standard oversize piston, supplied by the manufacturer, the body may be reclaimed in the following manner:

The cylinders are bored out 1/8 in. larger than the original size, up to the lower edge of the air port. This operation is done by clamping the body to an angle plate and in turn to the face plate of the lathe; the body is then bored from the inside of the cylinder up to the lower edge of the air port. A bushing made of low carbon machine steel is then passed through the side plate opening and pulled in place with a bolt and washers made for the purpose. This work is all done with the body still attached to the face plate of the lathe. The bushing is now bored out to fit a new standard size piston.

The cost of boring cylinders and making and applying four bushings will not exceed $4.00. This is very low compared to the cost of a new body which would otherwise have to be applied. This method of reclaiming was tried about three years ago and proved successful; the motor repaired then is still giving first class service. It is seldom that all four cylinders have to be bushed, and accordingly the cost of reclaiming is in proportion to the number bushed.

After the motor is assembled it is run slowly without load for approximately two hours so that the pistons will wear in perfectly. It is then tried out under load for about one-half hour, at all times being well lubricated with a mixture of Keystone No. 2 grease and valve oil proportioned 10 lb. of grease to 1 1/2 gal. of oil. With this mixture it has been found that the grease will reach all parts of the motor and will not lump up or stick to the walls of the cylinder. This method of bushing cylinders can be applied to corner motors as well as to the four-cylinder type motors. Several corner motors have been repaired in this manner and are giving satisfactory service.

Oversize valves can now be obtained which eliminates the application of new valve bushings. When a valve bushing is scored, all that is necessary is to ream it to the size of the oversize valve, thereby reclaiming the bushing and eliminating the tedious job of setting the bushings correctly. It also saves the cost of a new valve bushing and labor to apply it.

It has been claimed that motors with oversize valves will not have as much power as motors with standard valves. This condition has not been experienced at Beach Grove. Every motor repaired is tried out on a prony brake testing

machine and a record is kept of its pulling capacity. This record is compared with the records of all new motors put in service.

One of the numerous minor troubles is the sticking of valves in live air handles due largely to moisture in the air. When stuck, workmen will sometimes use a hammer or pipe wrench to loosen them, sometimes doing more damage than good. When handles get in bad condition they should immediately be attended to, for a leaky handle is a loss to the company. It costs considerable to produce compressed air, and all air leaks are a loss of energy, which means increased expense.

It has been found that supplying each individual gang on boiler work with motors best suited for their work, increases production, and the motors are better taken care of, because each gang is charged with the motors and held responsible for them.

On the erecting floor each gang foreman is assigned enough motors for the class of work he supervises and he is held responsible for them and sees that they are used in the proper manner. Twice a week a man is sent out to oil motors and check up and report motors that are not in good condition. These are sent to the toolroom for repairs as soon as reported. The motors out in the shop are oiled with a mixture of valve oil and motor oil, mixed 4 gal. of valve oil to 1/2 gal. of motor oil.

Worn spindles in air motors should be replaced with new, as it is not only injurious to the motor when a drill jumps out of the tang slot, but it also often ruins the tang on the drill. Workmen should be instructed to use the extractor pins in air motors for removing tools and not be allowed to strike drills or reamers with a hammer to get them out of the socket.

Air Hammers

Air hammers, like air motors, must be kept in first class repair so that they may deliver full power to the work. Here too, we must get 100 per cent repairs at a minimum repair cost, which can be done by reclaiming some of the different parts that go to build up a hammer.

Valve blocks are reclaimed in the following manner: The valve block is closed .012 in. by pressing it through a hardened steel block. It is then reamed to the standard size and a new valve applied. The life of a reclaimed block with new valve is equal to a new valve and block. The cost of reclaiming a valve block is $.50 plus the cost of a new valve. When the block is again worn large, it is reclaimed by reaming it oversize .002, .004 or .006 in., whichever the case may be, and an oversize valve is applied. These oversize valves are now furnished by all pneumatic tool manufacturers.

In this manner a valve block can be reclaimed five times and approximately 3 1/2 years' service obtained from the original block and five new valves.

The closed-in valve blocks are first reamed with a roughing reamer and finished with a finishing reamer, using raw linseed oil as a lubricant. This gives the valve a smooth finish equal to the polished surface made by the action of the old valve. In reclaiming handles it is often necessary to apply a larger hose connection because the original threads are stripped. To repair a handle of this kind quickly, it is necessary to have in stock connections with standard 1/2-in. pipe threads for the hose connection end and threaded on the other end to fit the handle, which has been tapped with an oversize pipe tap. The connections are also fitted with a strainer.

The application of a connection of this kind also standardizes the hose connections in the shop. Sometimes the handle wall is too thin to re-tap. These have been successfully repaired by brazing the connection in the handle. Handles fitted with piston throttle valves will stick when they become rusty from moisture in the air, and if they are not used every day the valve will become pitted. When cleaned or polished they will leak. Leaks are expensive, so it is best to get the full benefit of the air pressure by reaming the valve bushing and applying an oversize throttle valve to stop the leak. Lubricate the hammer before putting away until the next time used.

A good many hammers have been equipped with ball throttle valves and we find them far superior to the piston throttle valve; they are easy to apply, low in upkeep cost and have no air leaks.

Hammer barrels are good for about one year when used on steel car work, the life of the barrel being greatly reduced owing to the fact that some operators will grind the piston to about 1 1/8 in. long. Short plungers cause the barrel to wear large at the snap end where they strike the rivet set which causes the hammer to lose power. Plungers shorter than 1 3/4 in. should not be used.

On boiler and machinist work, longer plungers are used, which greatly increases the life of the barrel. Barrels that are worn are closed up approximately .020 in. by heating and swedging in dies made for this purpose. They are then reamed out in the lathe; the barrel is held stationary in a chuck fitted to the crossfeed of the lathe; the reamer is held in the lathe chuck and linseed oil is used as a lubricant. A roughing reamer and finishing reamer are used. The barrel is then chucked in the lathe and bored for the rivet snap. The valve block seat is reamed on the bench with a special reamer which is held in line by a cap which screws on the hammer barrel.

Workmen that use air hammers regularly are supplied with them and retain them as long as they are on work that requires the use of a hammer. When their work is changed, or they leave the service of the company, they must turn them in before they can get a release. All hammers are lubricated and tested in all positions on a large steel block which is kept in the toolroom for this purpose.

Open End Wrenches

At the 1923 convention E. J. McKernan, supervisor of tools of the Atchison, Topeka & Santa Fe at Topeka, Kans., was appointed a special committee of one to investigate and

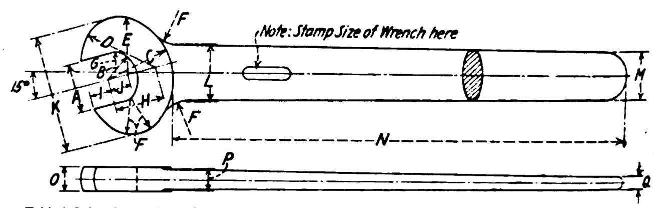


Table 1-Detail Dimensions of Proposed Standard Open-End Wrench for Locomotive Use-Sizes 1/2 in. to 2 1/2 in.

Size of Nut	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1/2 in.	31/32	9/16	1 5/16	1 5/16	1 3/16	3/8	1/4	11/16	9/16	9/32	2 7/8	1 1/4	1	10	1/2	3/8	1/4
5/8 in.	1 1/8	21/32	1 1/2	1 11/16	1 3/8	1/2	5/16	1 1/16	19/32	7/16	2 3/4	1 3/8	1 1/8	11	5/8	1/2	3/8
3/4 in.	1 5/16	25/32	1 7/8	1 21/32	1 5/8	7/8	5/16	1 1/4	19/32	1/2	3 1/4	1 1/2	1 1/4	12	3/4	5/8	3/8
7/8 in.	1 1/2	7/8	2	2 5/16	1 13/16	1	5/16	1 1/2	11/16	5/8	3 5/8	1 1/4	1 1/2	14	3/4	5/8	3/8
1 in.	1 11/16	1	2 3/16	2 11/16	2	1 1/8	3/8	1 13/16	3/4	11/16	4	1 7/8	1 5/8	15	7/8	3/4	1/2
1 1/8 in.	1 15/16	1 1/8	2 1/2	3	2 1/4	1 1/4	3/8	2	13/16	3/4	4 1/2	2 1/8	1 3/4	16	1	3/4	1/2
1 1/4 in.	2 1/16	1 1/4	2 5/8	3 3/8	2 5/16	1 1/2	3/8	2	7/8	13/16	4 5/8	2 1/4	1 3/4	18	1	3/4	1/2
1 3/8 in.	2 1/4	1 5/16	2 11/16	3 5/8	2 7/16	1 5/8	1/2	2 1/2	15/16	7/8	4 7/8	2 3/8	1 3/4	19	1 1/8	7/8	5/8
1 1/2 in.	2 7/16	1 7/16	2 7/8	4	2 5/8	1 3/4	1/2	2 7/8	15/16	7/8	5 1/4	2 1/2	1 3/4	20	1 1/8	7/8	5/8
1 5/8 in.	2 5/8	1 1/2	3 1/16	4 1/4	2 7/8	1 7/8	1/2	3	1	15/16	5 3/4	2 1/2	1 3/4	21	1 1/4	1	5/8
1 3/4 in.	2 13/16	1 5/8	3 5/16	4 3/4	3	2	1/2	3 1/2	1 1/16	1	6	2 3/4	2	22	1 1/4	1	5/8
2 in.	3 1/4	1 7/8	3 11/16	5 5/8	3 1/2	2 1/8	1/2	4 1/4	1 1/4	1 1/4	7	3	2	23	1 1/4	1	5/8
2 1/4 in.	3 9/16	2 1/16	4 3/16	6	3 5/8	2 1/4	5/8	4 1/2	1 1/4	1 5/16	7 1/4	3 1/4	2 1/4	24	1 1/4	1	5/8
2 1/2 in.	3 15/16	2 1/4	4 5/8	7	4	2 1/2	5/8	5 5/16	1 3/8	1 3/8	8	3 1/2	2 1/2	25	1 1/4	1	5/8

Proposed Standard Open-End Wrench for Use in Locomotive Shops and Enginehouses

report on the possibility of standardizing and getting some reliable firm to manufacture wrenches for locomotive shop and enginehouse use. After considerable experiment a

wrench was developed as shown in one of the drawings, being made in accordance with the detailed dimensions shown in Table I. This is strictly a locomotive wrench for back shop and enginehouse use. The wrench is sufficiently rugged to be used with a pipe or flue extension on the handle and will stand abuse with a sledge hammer. The width of the jaws is such that the wrench will fit a standard locomotive nut but not a finished nut.

This wrench is semi-finished, being cut with the acetylene torch out of a piece of soft steel of .20 to .30 carbon. The burrs are ground off and the wrench finished. The head of the wrench is case hardened just enough to toughen it.

Mr. McKernan stated that a company has been found which is willing to make wrenches in accordance with these specifications, giving a guarantee against defects and charging a range of prices from 90 cents for the smallest to $4.50 for the largest wrench. The Association voted to adopt this wrench as standard and went on record to the effect that considerable economy can be realized in purchasing wrenches instead of making them as they are being made today with so many failing to stand up under severe service.

Jigs and Fixtures

By F. U. Baker
Tool Foreman, Baltimore & Ohio, Pittsburgh, Pa.

The cost of repairing cars and locomotives is determined to a considerable extent by the number and quality of labor-saving jigs and devices used in railroad shops. The following jigs or fixtures were developed in the Glenwood shops of the Baltimore & Ohio and have given good satisfaction in service.

Truing Trunion Bushings

A tool for truing the trunion bushings on link plates, shown in Fig. 1, can be used in a drill press with a considerable saving of time over that required when performing this operation on a boring mill. The turning of eccentric crank arms is another operation which can be profitably per-

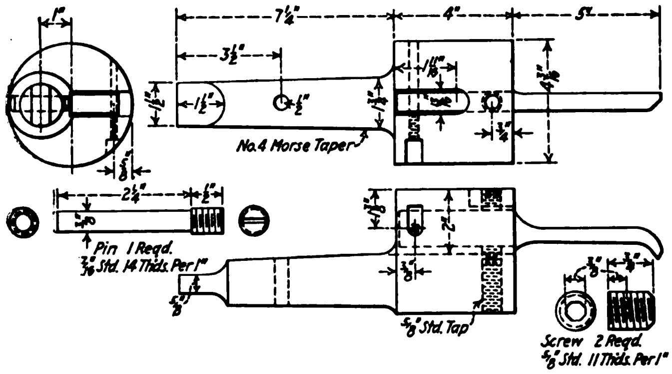


Fig. 1—Tool for Truing Link Trunnion Bushings

formed by the use of this tool, owing to the fact that the entire arm does not have to be revolved, which would require placing it on a boring mill table, or large lathe face plate.

It will be noticed that the cutting tool extends into the offset main body of the tool which is provided with a No. 4 Morse taper shank to fit in the drill press spindle. The cutter is pivoted at the upper end on a ⅜-in. pin, and ½-in. adjustment of the cutting point is obtained by means of the two set screws shown. This will allow proper adjustment of the cutting point for bushings of different size.

Replacing Locomotive Springs

The details of a device, recently designed for removing or replacing locomotive driver and trailer springs, are shown in Fig. 2, representing an improvement over the former methods of performing this operation. An overhead crane was formerly employed, necessitating considerable manual effort in guiding the springs into place on account of interference with the running board or cab.

Referring to the illustration, the device consists of a bar 7 ft. 11 in. long with a fork end, to each prong of which is connected a ⅜-in. chain, 36 in. long, fastened with I-bolts as shown. The prongs or fork end of this bar is placed on

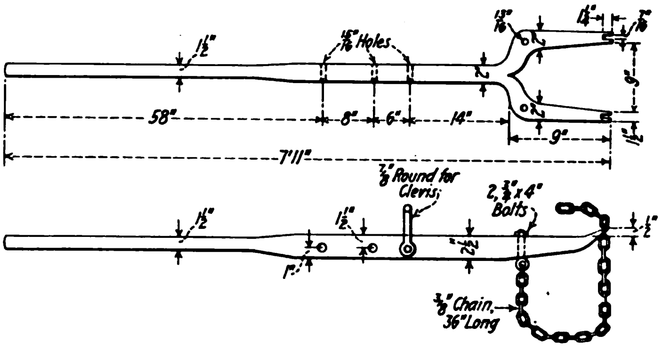


Fig. 2—Device for Removing or Applying Heavy Locomotive Springs

top of the spring, the two chains being brought under the spring and fastened in the ends of the prongs, thus forming a sling in which the spring rests. The overhead crane hook is fastened in the clevis in the bar and raises the spring, while a workman handles the opposite end, guiding the spring into place. The clevis is adjustable to three positions, all of which are off center thus enabling one man to balance a spring easily.

By using this device, springs can be handled either for removal or replacement in a short time and with relatively

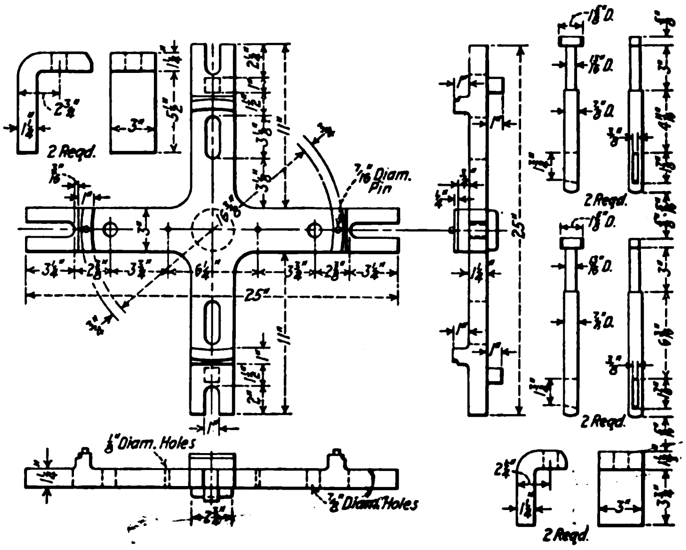


Fig. 3—Jig for Turning and Boring Eccentric Strap Bushings

little physical effort. The overhead crane chain does not come into contact with any other part of the locomotive. The device has been used for handling driver brake cylinders, but in this case the chains form a sling and the cylinder is allowed to rest on top of the prongs while the chains are brought over the top and fastened.

Machining Eccentric Strap Bushings

The machining of eccentric strap bushings previous to the development of the jig shown in Fig. 3 was performed on an engine lathe requiring three operations as follows: Bushings

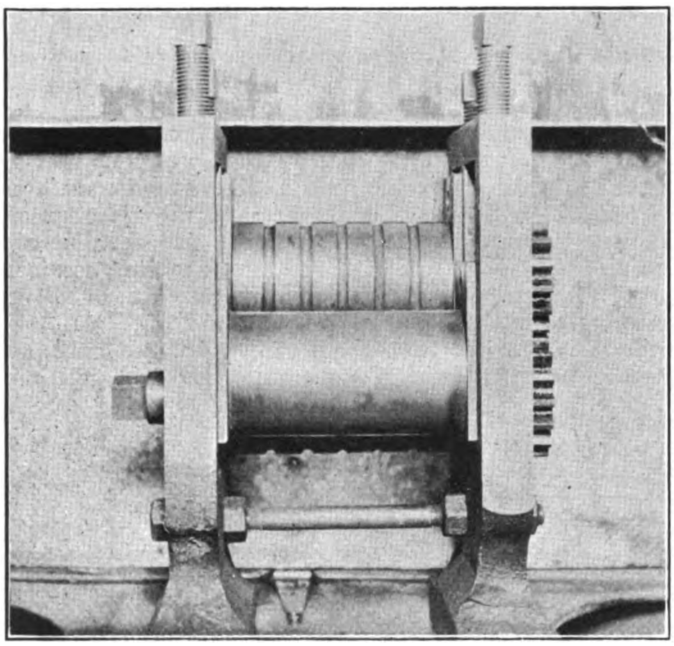
chucked for turning one-half of the outside; bushings re-chucked for turning the remainder of the outside; bushing re-chucked for boring the inside complete.

By adopting the jig illustrated it is now possible to perform this work on a small boring mill and eliminate the re-chucking operation. The work is now handled to completion on the boring mill.

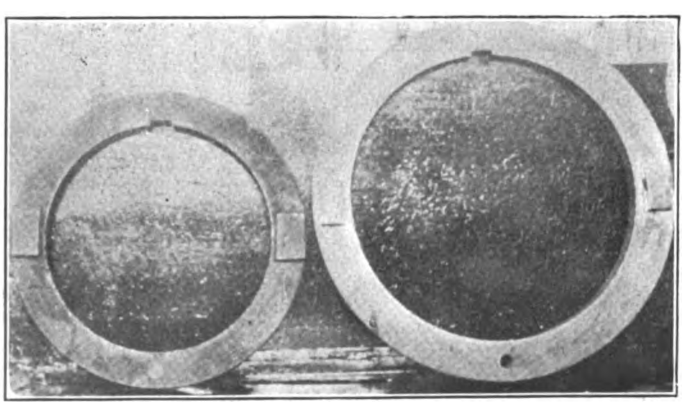
Reclaiming Brake Cylinder Packing Expanders

By Archie Skinner
Air Brake Foreman, A. T. & S. F., Corwith, Ill.

A LARGE amount of brake cylinder expander rings that were distorted and otherwise unfit for further service were being received in the reclamation yard of the Atchison, Topeka & Santa Fe, at Corwith, Ill. To prevent these rings from being used for other than the purpose for which they were originally designed, the writer, after trying out several methods for reclaiming them, found that it was too slow to anneal, true up on the anvil and then re-temper each ring. This method involved so much labor and expense that its continuance was out of the question. Finally a set of rolls was made similar in design to those used in a tin shop. These rolls were made of tool steel so as to prevent burring up the grooves when the rings were being passed through.

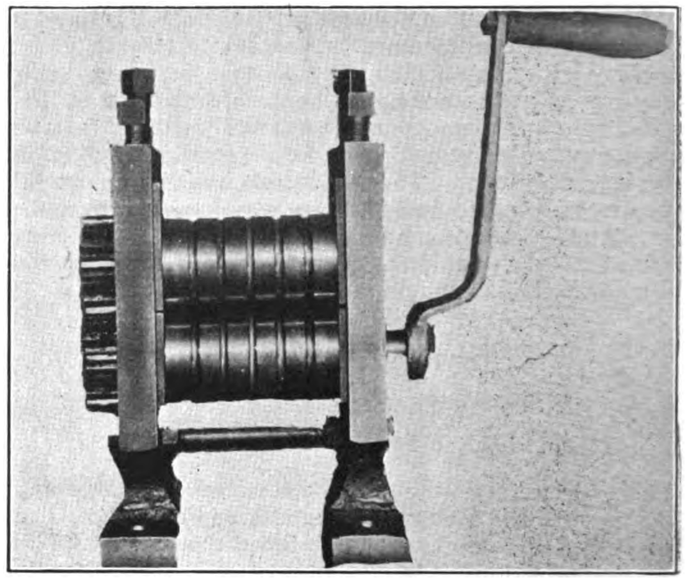


Rear View of the Rolls Showing the Idler



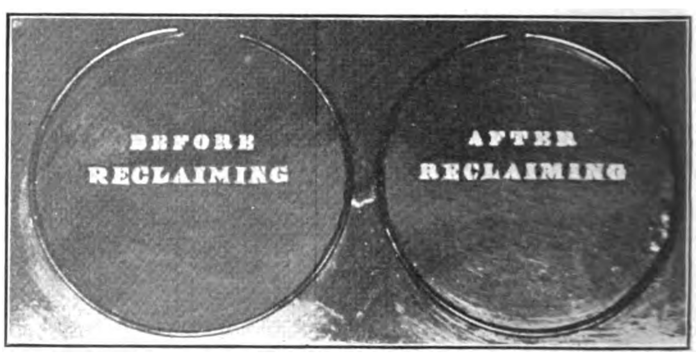
Checking Blocks Used to Determine Whether Ring Conforms to Standard Dimensions

A front view of the rolls is shown in one of the illustrations. The three grooves on the left are for the 8-in. rings and the two on the right are for the 12-in., 14-in., 16-in. and 18-in. rings. Screws for adjusting the rolls are located on the top of the frame. The rings are passed through the grooves of the two front rolls and over an idler in the rear. Adjustments of the three rolls may be made so as to give the rings the correct set. Referring to the illustration of the two views of an expander, the ring on the left, which has not been reclaimed, has a large opening at the top and it is also out of round. The ring on the right has been rolled so that the opening at the top is standard and the ring is perfectly round.



Front View of the Rolls

Checking blocks are also provided for this work, which are used to determine if the ring conforms to Westinghouse standard dimensions. These checking blocks can be made either in the shop or purchased from the Westinghouse Air Brake Company. They can readily be made in the shop as they require no complicated machinery.



An Example of the Kind of Work Done by This Machine

A record of the first day's run showed that there was a total of 270, 10-in. rings and 255 8-in. rings reclaimed. Since the first trial we have reclaimed 700 rings at a saving of at least half of what it would cost to buy these rings new from the manufacturer. A recapitulation of the savings ef-

fected from the first day's trial showed that the cost to reclaim 270 10-in. rings at nine cents each was $6.28, thereby saving $18.02. The cost to reclaim 255 8-in. rings was also $6.28, which also effected the total saving of $14.12.

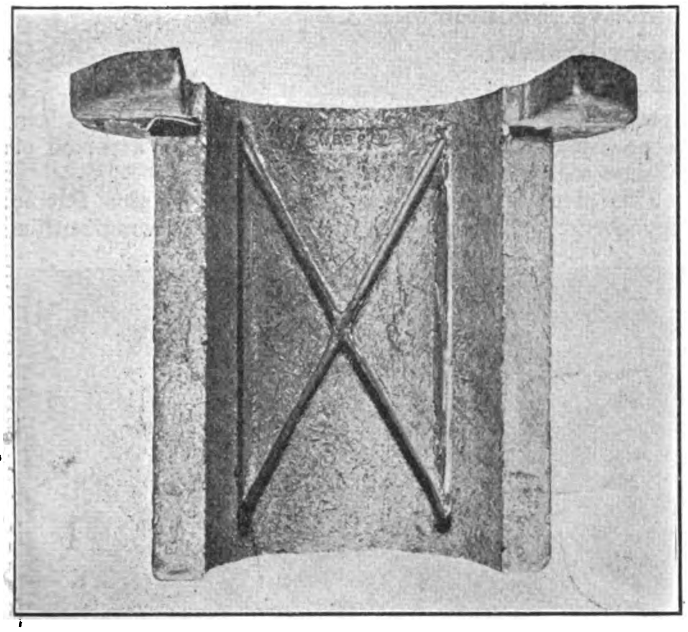
The rolls are operated by hand power; they can be used anywhere.

One Piece Crown Brasses Eliminate Waste

Grease Grooves and Flange Cast on the Brass—Net Saving of $1.50 Per Box Obtained

By Millard F. Cox
Assistant Superintendent Machinery, Louisville & Nashville, Louisville, Ky.

ONE source of waste with which I am familiar, is driving box crown brasses, a detail common to all railroads, and nearly standard except for some minor differences. Crown brasses for locomotives have grown into huge castings, weighing from 220 lb. to 280 lb. each. They are from 1¾ in. to 2½ in. thick. All of them require machining on the outside and inside, which work is done on a boring mill, shaper, or lathe, according to the equipment at hand. The grooves required for heavy grease, the kind which is standard to nearly every railroad, are either milled or cut in with a pneumatic chipper. After the crown brass is carefully fitted and pressed into the driving box, it is ready for the bronze face which is poured directly into the recessed opening of the box. After hammering this bronze to insure a solid backing, the box is then faced off smooth so as to bring the bronze ring face and the crown brass end into the same plane, or flush with each other.



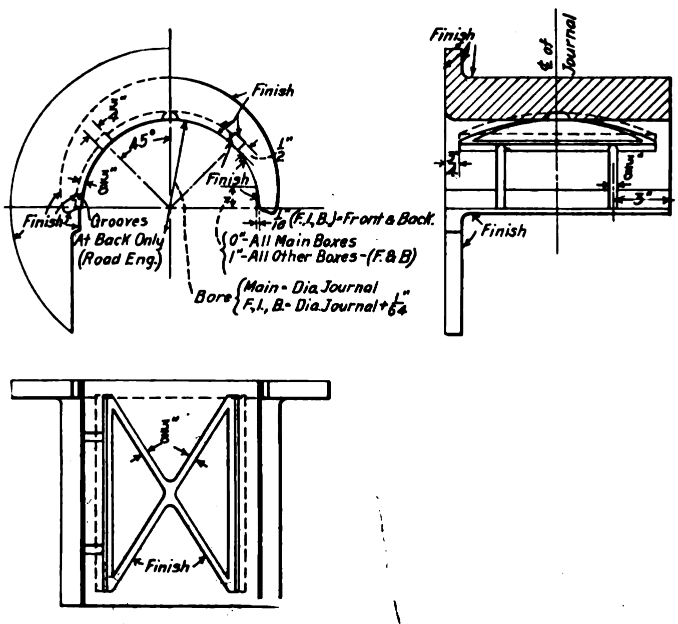
Crown Brass with Flange and Grease Grooves Cast Intregal

There are a number of distinct losses in this practice, namely, the loss of fuel and metal in casting on the bronze face; the loss of metal in machining the bronze face; the loss of time rehandling the box while casting on the bronze face; the loss of metal due to cutting the grease grooves in the crown brass; the loss due to wear and tear on air tools, and the loss of time chipping the grooves and dressing them up.

The above is standard practice in most railroad shops, varying a little as to the style and number of grease grooves and hub face arrangement. Sometimes a bronze ring face is cast into the driving wheel hub working against the cast steel box face, but this is not a satisfactory enginehouse proposition.

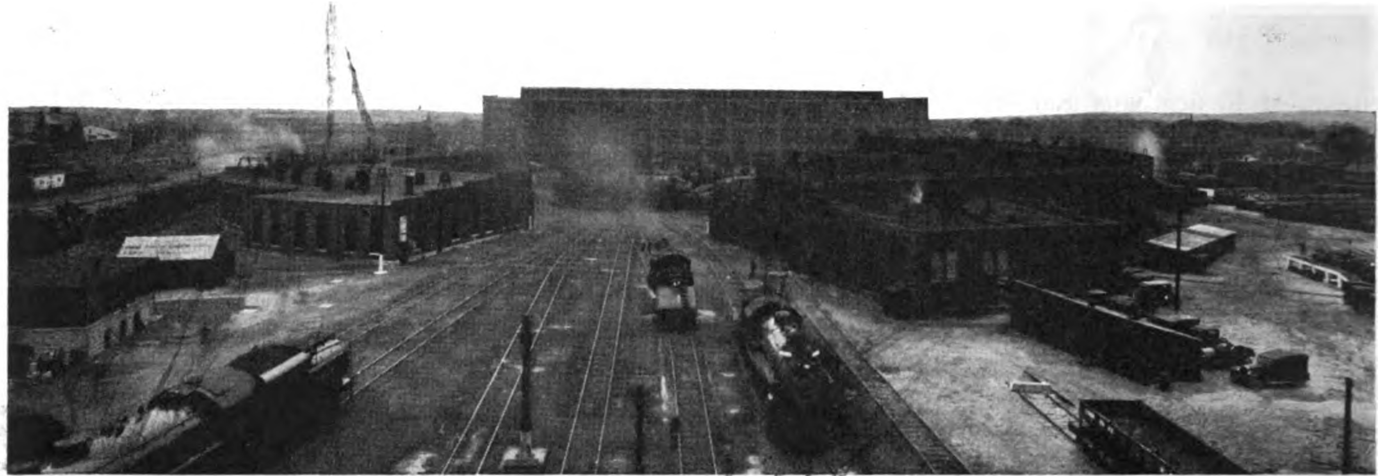
In order to overcome these losses of time, material and equipment, we adopted several years ago, a one-piece crown brass with the flange cast integral as shown in the illustration. This style crown brass requires only two operations in the finishing, boring and facing the inside of the flange, and shaping the two edges. It is then pressed into the driving box and is complete, ready for the final boring and facing.

The grease grooves are cored into the crown brasses by an improved foundry method deserving of special notice. A system of metal cores is implanted firmly into a half circle dry sand core so as to form clean spaces, mechanically perfect in contour. It is obvious that this method may be varied to conform to any desired style or system of grease grooves. One piece style crown brasses have been used in different parts of the country for a long time, but have not been generally adopted.



One Piece Crown Brass Showing Finished Dimensions for Grease Grooves and Flange

By the use of this design we have obtained a much better wearing flange, as the metal is more uniform, besides it establishes an absolute standard for grease grooves in exact accordance with drawings, something which could not be obtained before. The foundry labor, and extra core work, as anticipated, has added some extra expense to the production of the castings, but after a test of six or seven years, we find this is fully justified. By the most conservative system of accounting, we find there is a tangible net saving of about $1.50 per average box.



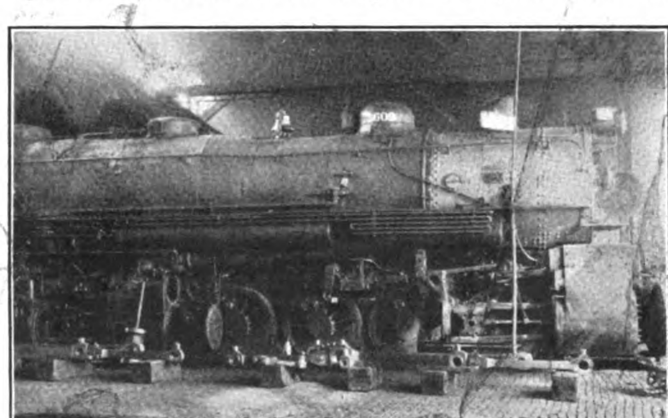
Union Pacific Enginehouse at Cheyenne, Wyo., with the Locomotive Shop in the Background

Union Pacific Systematizes Running Repairs

Periodical Detentions Reduce Locomotive Maintenance Costs 10 Per Cent with Increased Service

THE exacting transportation requirements attendant on the establishment of long locomotive runs on the Union Pacific has given the problem of improvement in terminal attention and repair methods particular importance.

Prior to the inauguration of long runs, it was the practice on the Union Pacific to hold locomotives for repairs only as necessity arose. As a result, the handling of locomotives was not satisfactory; engines were out of service at frequent intervals for repairs; certain periods for boiler work and others for machinery repairs. In addition, the mechanical department was not always in a position to know the condition of an engine with reasonable assurance until an inspection was made. Experience also showed that too much dependence was being placed on the engineman's report of the condition of an engine. Delays occurred constantly owing to minor defects not reported by either the engineman or the inspectors.



A Separate Gang Handles the Mallet Locomotive Repair Work

In order to overcome these unsatisfactory features, a systematic program for handling repairs was established. Under this system, when a locomotive is held for a regular monthly inspection as required by the federal law, it is now the practice to hold it long enough to perform all the work required to put it in condition to perform service until the next periodical inspection is due. It has been found that with the ordinary daily trip inspections, and very light running repairs during the interval, locomotives can be prepared for and successfully operated over a period of 30 days with results that are very gratifying.

This plan was first put into effect at the Union Pacific enginehouse at Cheyenne, Wyo., and the following outline of the system at that point will serve to show the method of handling the work and the results accomplished.

Cylinder and Valve Work is Handled by Specialized Gangs

Organization for Handling the Work

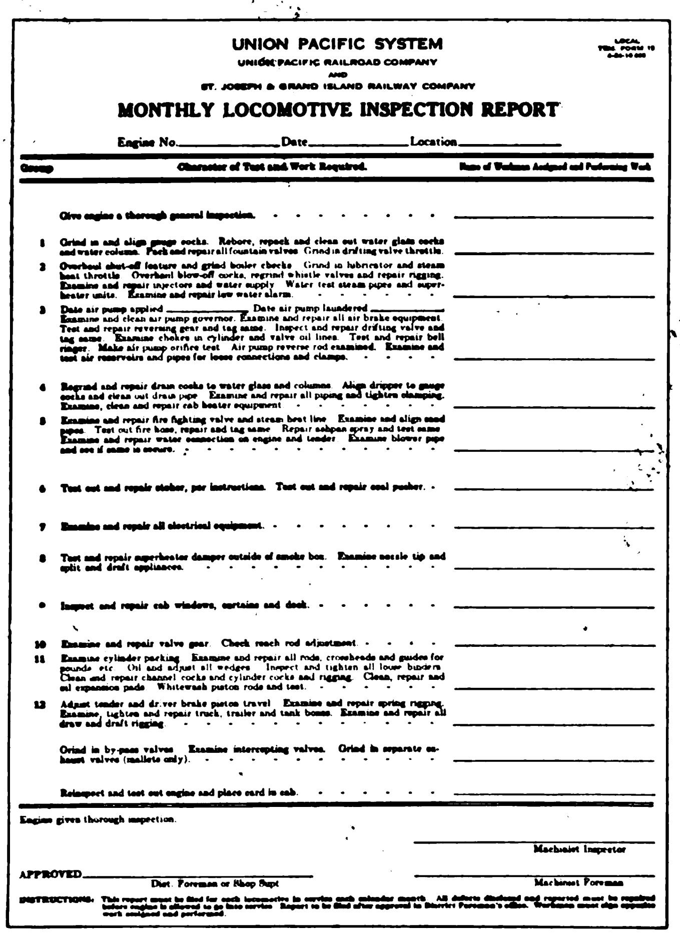
The enginehouse organization at Cheyenne has been divided into three specialized gangs to handle respectively, passenger locomotive repair work, mallet locomotive repair work, and freight locomotive repair work. The first two gangs are under the supervision of the roundhouse foreman and the third under the supervision of the assistant roundhouse foreman. Each of these gangs has been carefully organized according to the number of engines to be maintained and the requirements of the different types of locomotives handled by the gang. Men are assigned exclusively to certain work in order to secure the best possible results.

The use of two forms, samples of which are reproduced,

has been inaugurated to facilitate handling the work, and to establish a definite record of the inspections. One of these forms covers the various items connected with machinery inspection, and the other the boiler inspection. Each form provides space opposite the various items of work for the signature of the employee making the inspection and repairs, and both forms are duly approved by the officers in charge after final inspection of the locomotive under steam has been made.

Character of Work and Time Expended

Locomotives are given a thorough inspection, and all work shown on the forms is taken care of, together with



UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD COMPANY
AND
ST. JOSEPH & GRAND ISLAND RAILWAY COMPANY

MONTHLY LOCOMOTIVE INSPECTION REPORT

Engine No.________ Date________ Location________

Group	Character of Test and Work Required.	Name of Workman Assigned and Performing Work
	Give engine a thorough general inspection.	
1	Grind in and align gauge cocks. Rebore, repack and clean out water glass cocks and water column. Pack and repair all fountain valves. Grind in drifting valve throttle.	
2	Overhaul shut-off feature and grind boiler checks. Grind in lubricator and steam heat throttle. Overhaul blow-off cocks, regrind whistle valves and repair rigging. Examine and repair injectors and water supply. Water test steam pipes and superheater units. Examine and repair low water alarm.	
3	Date air pump applied ______ Date air pump laundered ______ Examine and clean air pump governor. Examine and repair all air brake equipment. Test and repair reversing gear and tag same. Inspect and repair drifting valve and tag same. Examine chokes in cylinder and valve oil lines. Test and repair bell ringer. Make air pump orifice test. Air pump reverse rod examined. Examine and test air reservoirs and pipes for loose connections and clamps.	
4	Regrind and repair drain cocks to water glass and columns. Align dripper to gauge cocks and clean out drain pipe. Examine and repair all piping and tighten clamping. Examine, clean and repair cab heater equipment.	
5	Examine and repair fire fighting valve and steam heat line. Examine and align sand pipes. Test out fire hose, repair and tag same. Repair ashpan spray and test same. Examine and repair water connection on engine and tender. Examine blower pipe and see if same is secure.	
6	Test out and repair stoker, per instructions. Test out and repair coal pusher.	
7	Examine and repair all electrical equipment.	
8	Test and repair superheater damper outside of smoke box. Examine nozzle tip and split and draft appliances.	
9	Inspect and repair cab windows, curtains and deck.	
10	Examine and repair valve gear. Check reach rod adjustment.	
11	Examine cylinder packing. Examine and repair all rods, crossheads and guides for pounds etc. Oil and adjust all wedges. Inspect and tighten all loose binders. Clean and repair channel cocks and cylinder cocks and rigging. Clean, repair and oil expansion pads. Whitewash piston rods and test.	
12	Adjust tender and driver brake piston travel. Examine and repair spring rigging. Examine, tighten and repair truck, trailer and tank boxes. Examine and repair all draw and draft rigging.	
	Grind in by-pass valves. Examine intercepting valves. Grind in separate exhaust valves (mallets only).	
	Reinspect and test out engine and place card in cab.	

Engine given thorough inspection.

________ Machinist Inspector

APPROVED________ Dist. Foreman or Shop Supt. ________ Machinist Foreman

INSTRUCTIONS: [illegible]

Monthly Locomotive Inspection Form Which Indicates the Extent of the Work Done at Each Monthly Repair Period

additional work which may be found necessary, such as dropping wheels, renewing flues, etc.

The average number of man-hours expended in performing this work on the different classes of locomotives at Cheyenne is as follows:

	Machinery work Man-hours	Boiler work Man-hours	Total Man-hours
Passenger locomotives	264	48	312
Mallet locomotives	330	72	402
Other freight locomotives	228	48	276

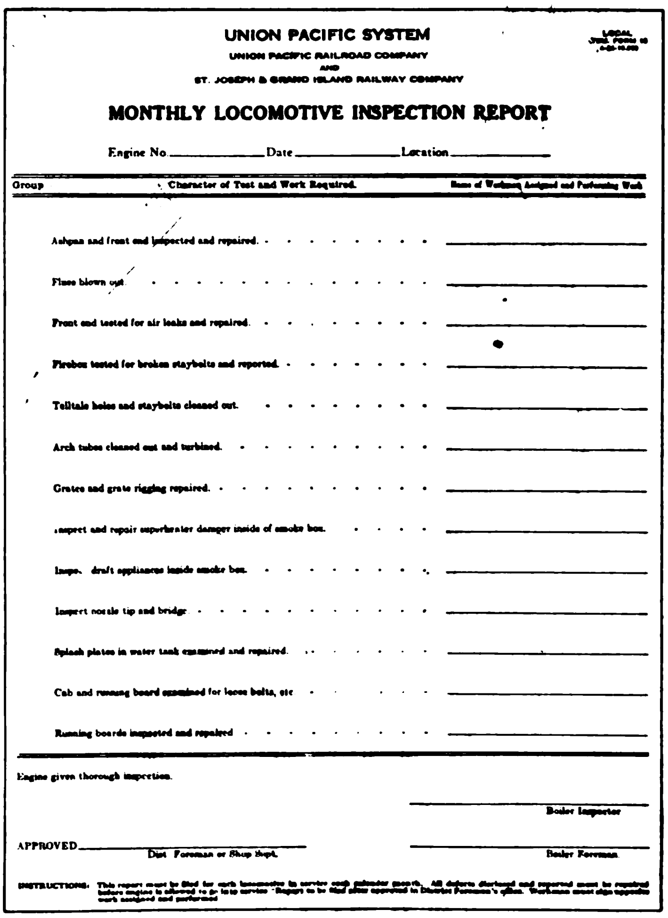
Increased Efficiency Obtained

The inauguration of this plan has practically eliminated the various minor defects which caused or contributed to engine failures, such as leaky boiler checks, gage cocks, brick arches, fireboxes, etc. A reduction of 60 per cent in freight locomotive failures per 100,000 miles was effected on the Union Pacific during the first six months of the present year, compared with the same period last year, and a reduction of 47 per cent in the number of passenger locomotive failures. The present average performance as regards engine failures is one failure per 100,000 locomotive miles. A better showing is anticipated when the system has become well established at all of the smaller roundhouses.

By means of periodical repairs, the Union Pacific has also been able to increase the monthly mileage of locomotives although at the present time, on account of the many other features involved, a definite statement regarding the amount of this mileage increase cannot be made. However, the available time of locomotives running out of Cheyenne has been increased from approximately 564 to 640 hours a month.

In addition it has been found that the present method of handling repairs effects a substantial decrease in the cost of maintaining power. A locomotive which formerly required an average of 615 man-hours a month for inspection and repairs is now repaired in 553 man-hours, or with a decrease of 10 per cent.

As previously stated, this outline covers the system for handling the work at Cheyenne. The practice and the results are substantially the same at all other large terminals on the Union Pacific. At smaller terminals, where the



UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD COMPANY
AND
ST. JOSEPH & GRAND ISLAND RAILWAY COMPANY

MONTHLY LOCOMOTIVE INSPECTION REPORT

Engine No.________ Date________ Location________

Group	Character of Test and Work Required.	Name of Workman Assigned and Performing Work
	Ashpan and front end inspected and repaired.	
	Flues blown out.	
	Front end tested for air leaks and repaired.	
	Firebox tested for broken staybolts and reported.	
	Telltale holes and staybolts cleaned out.	
	Arch tubes cleaned out and turbined.	
	Grates and grate rigging repaired.	
	Inspect and repair superheater damper inside of smoke box.	
	Inspect draft appliances inside smoke box.	
	Inspect nozzle tip and bridge.	
	Splash plates in water tank examined and repaired.	
	Cab and running board examined for loose bolts, etc.	
	Running boards inspected and repaired.	

Engine given thorough inspection.

________ Boiler Inspector

APPROVED________ Dist. Foreman or Shop Supt. ________ Boiler Foreman

INSTRUCTIONS: [illegible]

This Form Is Devoted to the Boiler and Its Appurtenances

number of locomotives handled does not warrant special gangs for the various types of locomotives, the work is being taken care of by men regularly assigned to certain definite items of work. The same forms are being used, and the same practice is followed in giving the engine periodical and systematic repairs.

By this system, the mechanical department officers of the Union Pacific believe that a considerable advance has been made toward solving some of the more important

problems on which depend the success of long locomotive runs.

Periodical repairs to locomotives give an assurance of power that can be relied on to meet transportation requirements at a cost for up-keep that is 10 per cent below the former cost, and with a substantial increase in the number of hours that power is available for service.

Machine for Locating Eccentrics on Axles

By L. V. Mallory
Gang Foreman, Missouri Pacific, Kansas City, Mo.

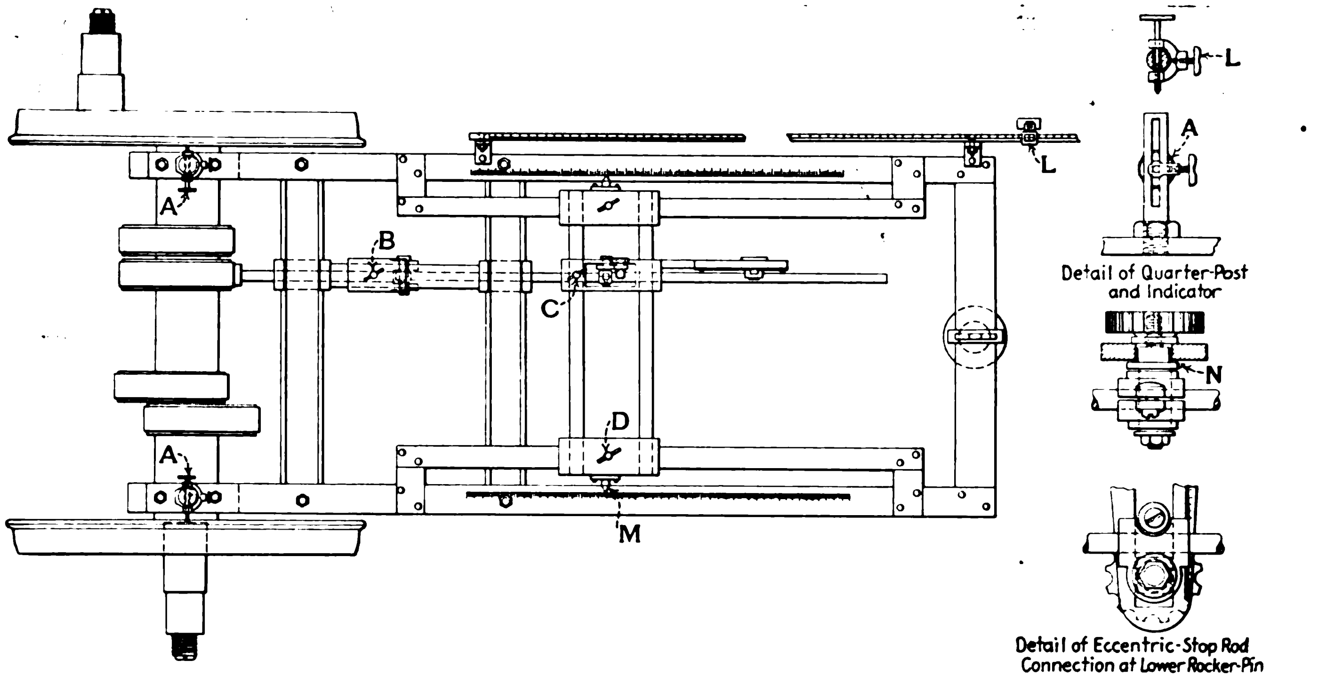
A MACHINE for locating eccentrics on the axle before it is placed under the locomotive has been developed and successfully used in the Kansas City shops of the Missouri Pacific. By its use considerable time is saved in setting the valves of a Stevenson valve gear locomotive as it eliminates the necessity of locating dead centers and changing the keys after the engine is assembled. The machine can be made with little expenditure in any railroad shop. The following is a detailed description of its construction and operation.

A rectangular frame, open at one end, is made from ¾-in. by 4-in. bar iron. At the open end a V-block is secured to the bottom of each leg which saddles over the journal of the axle to which the eccentrics are to be applied. On the upper side of each leg are secured two longitudinal guide bars which carry the rocker arm crossheads. These in turn carry the transverse guide rods on which are mounted the rocker arm and an indicator assembly consisting of an indicator and card holder.

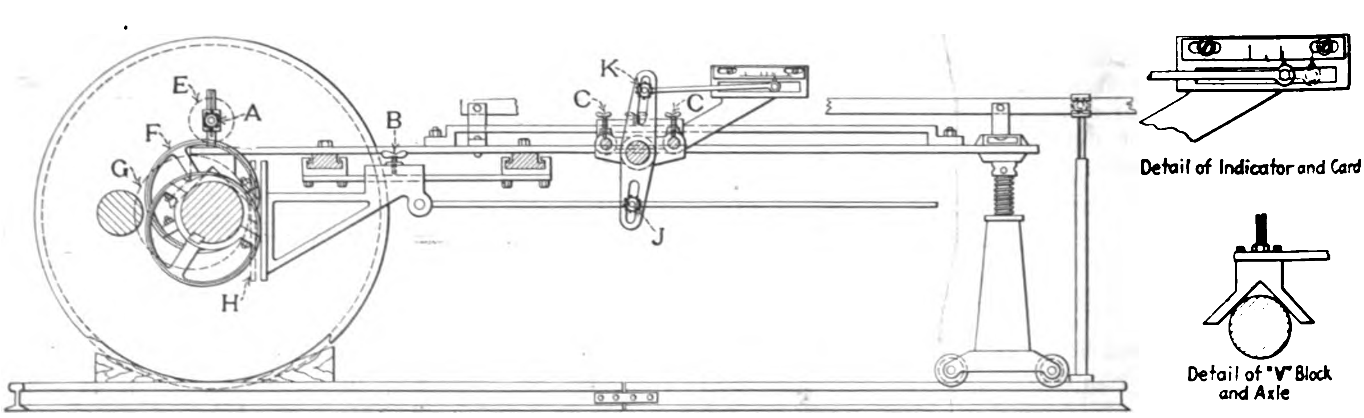
The rocker arm is made of light material, having at each end a slot of sufficient length for the movable pins to be adjusted to correspond to the valve rod pins and link block pins of various classes of engines on which the machine is to be used. For convenience, a scale is provided at the edge of these slots and a small indicator is located on a horizontal line through the center of each pin.

On the under side of the frame are two transverse guide bars located so that the eccentrics will clear the one nearest to the axle. These guides carry, suspended between them, the longitudinal guide on which is hung the eccentric stop. A small screw jack, which may be mounted on small wheels or castors, supports the front end of the locater frame which facilitates leveling adjustments. There is a small spirit level over the jack on the frame.

Above each of the V-blocks on the open end of the locater



Machine in Position for Locating the Left Forward Eccentric on an Outside Admission Indirect Engine



Eccentric Locater for Locating Locomotive Eccentrics Correctly on the Axle Before the Wheels Are Replaced

frame is a quartering post. These posts are slotted to receive crank pin indicator points which are secured by winged set screws to suit any crank pin throw and, when the frame is level, the points lie in a vertical plane through the center of the axle. On one leg of the frame and immediately over the rail is secured the guide of the main rod angularity finder and telescope scale. This guide is parallel with the frame and extends a sufficient distance beyond the end of the frame to accommodate the length of any main rod. On it is carried the angularity finder from which is suspended a telescope scale reaching down to the rail. The guide is graduated, zero being at the center of the quartering posts.

The drawings show the machine in position for locating the left forward eccentric of an indirect outside admission engine. Therefore, to avoid confusion, it will be assumed that this is the one to be located. First, place the wheels so that right crank pin is approximately at the top quarter. Place the locater frame in position with the closed end ahead of the wheels and the V-blocks resting on the journals. Level the locater frame with the jack. Find the distance between the centers of the front and back end main rod brasses and set the main rod angularity finder at the corresponding graduation on the finder guide. The next step is to find the distance the center of the crosshead pin is above or below the cylinder center line. Adjust the frame with the jack until a corresponding distance is recorded by the telescope scale. Roll the wheels slightly until the indicator point on the quartering post finds the center of the right crank pin, then block them securely in this position and bring the locater frame to a level position again.

Now put the eccentric on the axle in such a manner that it can be moved without disturbing the position of the wheels. Put the proper valve event card in the indicator and set the pins in the rocker arm in the position to correspond to those of the valve rod and link block pins in the actual rocker arms of the engine. With the stop rod connection screw released, slide the rocker arm crossheads until their indicator points rest on the graduations corresponding to the link radius of the engine. Secure the rocker arm in this position with the wing screws located on the rocker arm crossheads.

Turn the left forward eccentric on the axle until its thinnest part is between the axle and the eccentric stop and fix it temporarily in this position by one of its set screws. Then bring the eccentric stop back against the eccentric and secure it to its guide with the wing set screw.

With the connection screw still released, move the valve event indicator forward until it registers on the extreme forward valve travel mark of the indicator card. Then securely tighten the eccentric stop rod connection screw. This operation connects the eccentric stop with the indicator. Now release the eccentric stop on its guide and move it forward until the indicator registers on the lead line just ahead of the forward port mark, and again firmly clamp it to its guide. Release the left forward eccentric and bring it to rest on the eccentric stop, which is its correct location. Compare the keyway and order the key offset to suit.

Leaving the machine set as above, slide the longitudinal guide and rocker arm assembly over in alinement with the left backward eccentric. This eccentric may now be located, it being necessary, however, to move it upward until it meets the eccentric stop. In some cases less lead is desired in the backup position. This is accomplished by merely releasing the locking screw and placing the indicator closer to the port mark on the card and resetting the set screw.

Right side eccentrics are located by placing the left crank pin in the same position as now occupied by the right crank pin near the top quarter. The right crank pin, when in this position is on the forward dead center, hence the indicator must register near the back port mark and the right front eccentric moved upward to meet the stop and the right back eccentric downward to meet the stop.

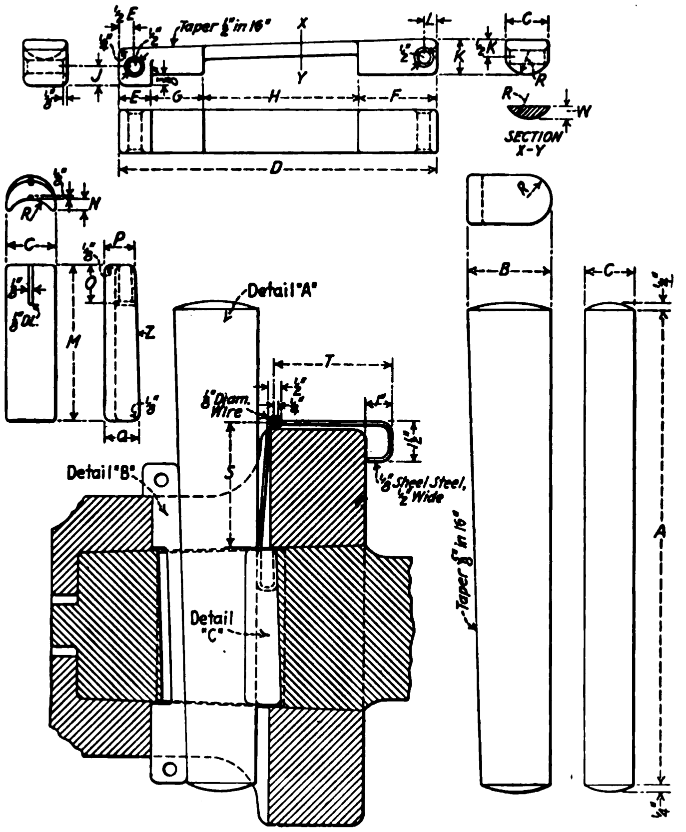
Locomotive Crosshead Puller

By E. A. Miller

THOSE who have experienced considerable trouble in cutting crossheads loose from the pistons will find the device shown in the illustration a time saver in doing this job. It is simple in construction, easy to handle and in no way difficult to apply.

The device consists of four parts which are made from axle steel. The detail *A* is the wedge which is driven in to pull the crosshead. It is a piece of steel tapered 5/8 in. in 16 in. Detail *B* is a steel block which is placed toward the rear end of the crosshead. It is flat on the side which bears against the wedge *A*, but is rounded in three places on the opposite side, two of which fit against the rounded end of the key slot in the crosshead. The recessed portion in the center is rounded to fit in the end of slot in the piston rod when the crosshead has been drawn loose from the rod.

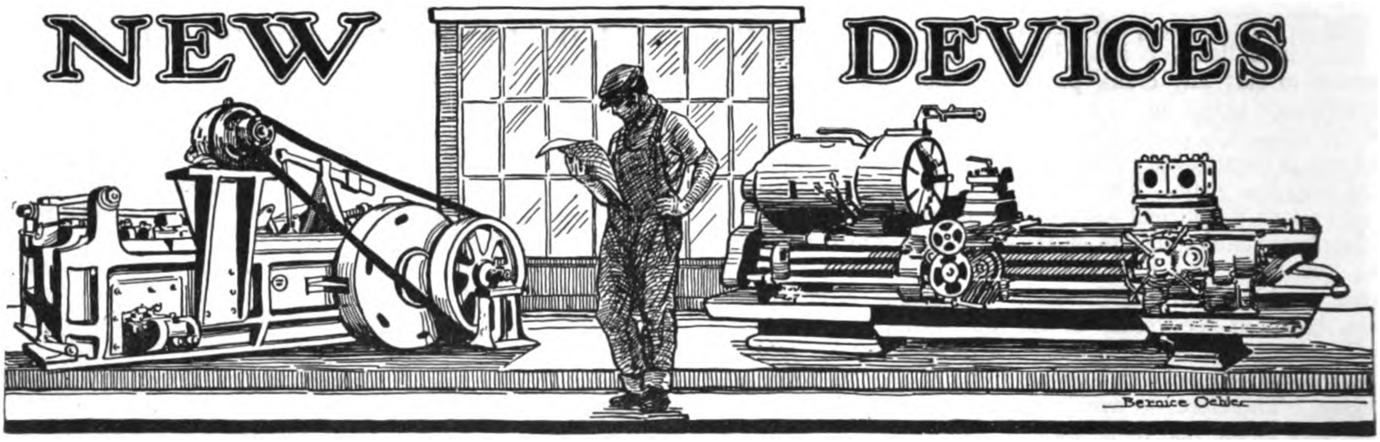
Detail *C* is a small block slightly shorter than the diameter of the piston rod at the slot where it is used. It is crescent



Effective Crosshead Puller Adaptable to Enginehouse and Back Shops

shaped on the end, the outer radius to fit the corresponding half-round end of the keyway in the piston rod, while the inner radius is the same as that on the rounded side of the key. A 1/8-in. hole is drilled through this block and a 1/8-in. groove is cut along both rounded surfaces at the upper end. This is for the purpose of receiving a 1/8 in. wire to hold the block in place. The wire extends to the outside of the crosshead ring and there goes through a 1/8-in. by 1/2-in. steel plate which hooks over the end of the crosshead and prevents the crescent block from turning laterally.

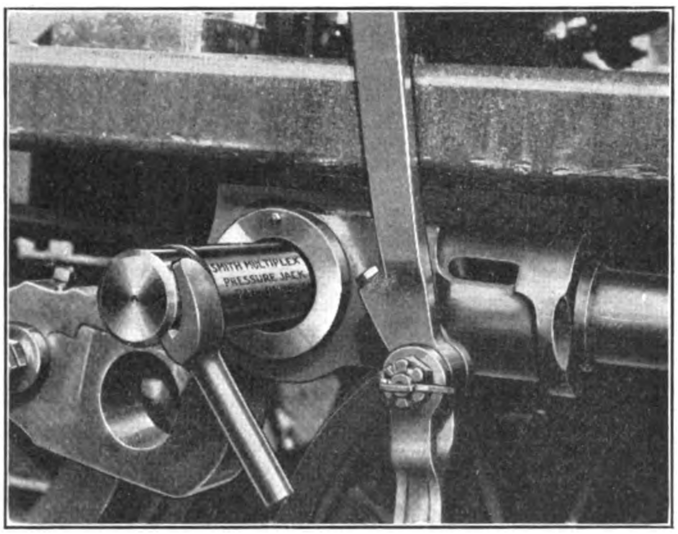
After setting up the device the crosshead barrel should always be heated slightly before using, as quicker results with less resultant damage to the puller will be obtained. When heating, it is advisable to protect the babbitt on the crosshead with sheets of asbestos so that it will not melt off.



Smith Multiplex Pressure Jack

A JACK that can be used in a 2-in. to 5-in. space and which has a lifting capacity from 25 to 100 tons has recently been designed by H. J. Smith, Philadelphia, Pa., and is designated as the Smith multiplex pressure jack. It is especially adaptable to the railway field and has been used with success in pulling pistons, loosening tight bolts, removing engine truck brasses, changing car and tender bearings and jacking-up equalizers when applying or removing driving, trailer and truck springs.

The cross-section of the jack shown in the illustration will give a clear conception of the construction and principle

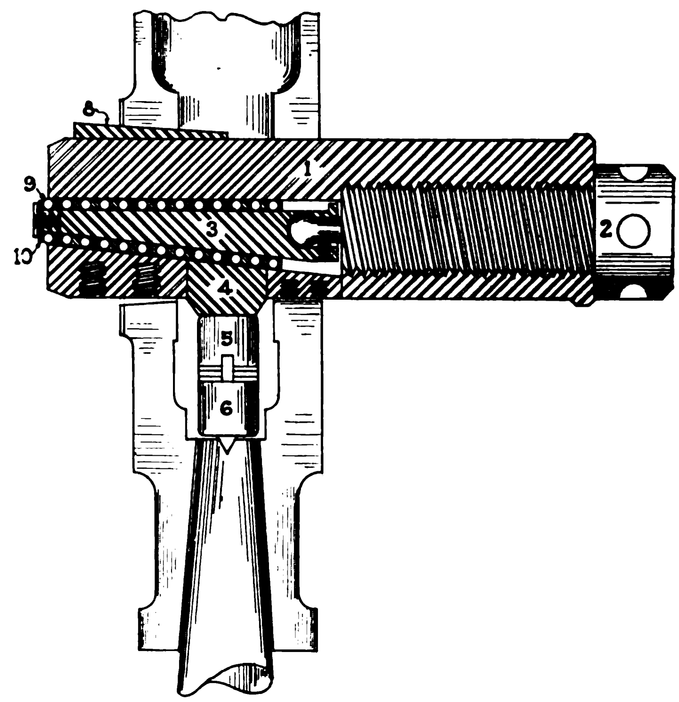


Forcing a Piston Rod from the Crosshead with a Smith Multiplex Pressure Jack

of the jack. It consists of a cylinder which is threaded for the pressure screw. The screw is drawn up against the longitudinal and transverse wedge which runs on roller bearings. The pressure is transmitted through the transverse wedge to the parts for which it is intended by means of suitable filler piece.

The operation of the jack is simple and it can be easily handled by one man. If the workman is going to force a piston from the crosshead, the jack is first placed in the wrist pin hole with the transverse wedge pointed toward the end of the piston rod. The pressure screw is run back by hand which also pulls back the longitudinal wedge. Before applying the pressure a final check should be given to see that the male and female filler piece is properly in place between the end of the piston and the transverse wedge. As the pressure is exerted on the longitudinal and transverse wedges the jack cylinder tightens in the wrist pin hole against the wedge shaped filler piece which is placed around the end of the jack.

In testing one of the jacks one man with a 19-in. bar is said to have lifted 81,000 lb., with a 4-ft. bar, 172,100 lb. and with a 6-ft. bar, 200,000 lb., or the limit of the testing machine. The capacity of the jacks is determined by the amount of taper in the wedges and the pitch of the threads on the pressure screw. The spring rigging and



1—Jack cylinder; 2—Pressure screw; 3—Longitudinal wedge; 4—Transverse wedge; 5 and 6—Filler pieces; 8—Liner pieces; 9—Roller bearings; 10—Roller frame.

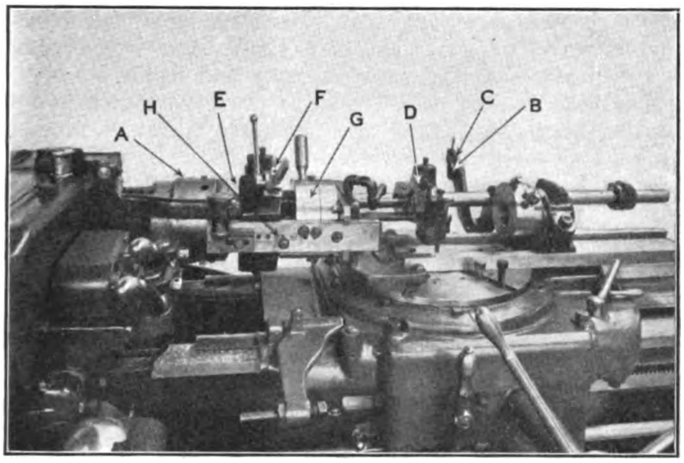
Cross-section View Showing the Construction and Principle of the Jack

journal jacks are made in three different sizes. The spring rigging jack is 4 in. over all, which means that it can be used in a 4-in. space, lifting 50 tons. The car and locomotive jacks are 5¾ in. over all and are furnished with filler blocks so that they can be used for all sizes of car wheels and journal boxes when removing journal brasses. There are six sizes of jacks ranging from 50 to 100 tons in capacity and weighing from 55 lb. to 100 lb. They vary only 2 in. in length, the smaller size being 21 in. long and the larger size 23 in. long.

Staybolt Attachment for the Hartness Flat Turret Lathe

THE staybolt attachment shown in the ilustration has been developed by the Jones & Lamson Machine Company, Springfield, Vt., in order to simplify the turning and threading of staybolts, particularly the button-head radial type where the use of both straight and taper threads complicates this operation.

This attachment provides a method for mounting on the turret of the Hartness flat turret lathe a long extension tool plate. On this are fixed tool holders carrying two automatic die heads. At the side of the tool plate is a rigid bar which carries two turning and centering tools. These may be drawn down into position to take turning cuts and then thrown back out of the way so the thread dies may be used.



Staybolt Attachment for Simplifying the Turning and Threading of Staybolts

The tool plate is made of steel and is amply proportioned to give sufficient strength. The die heads are the standard Hartness automatic die heads. They may be set in the proper lead relationship by setting them down onto a master staybolt of correct pitch relationship. The front die head may be arranged to cut either straight or tapered threads. A graduated dial attached to the templet may be set to cut threads either straight or at any desired taper.

The two turners are made of steel castings and are said to be rigid enough so that it is possible to take skimming cuts over the bolt using the coarsest feed on the machine. This whole attachment may be taken from the turret by removing four or five bolts, which leaves the machine free for its regular work.

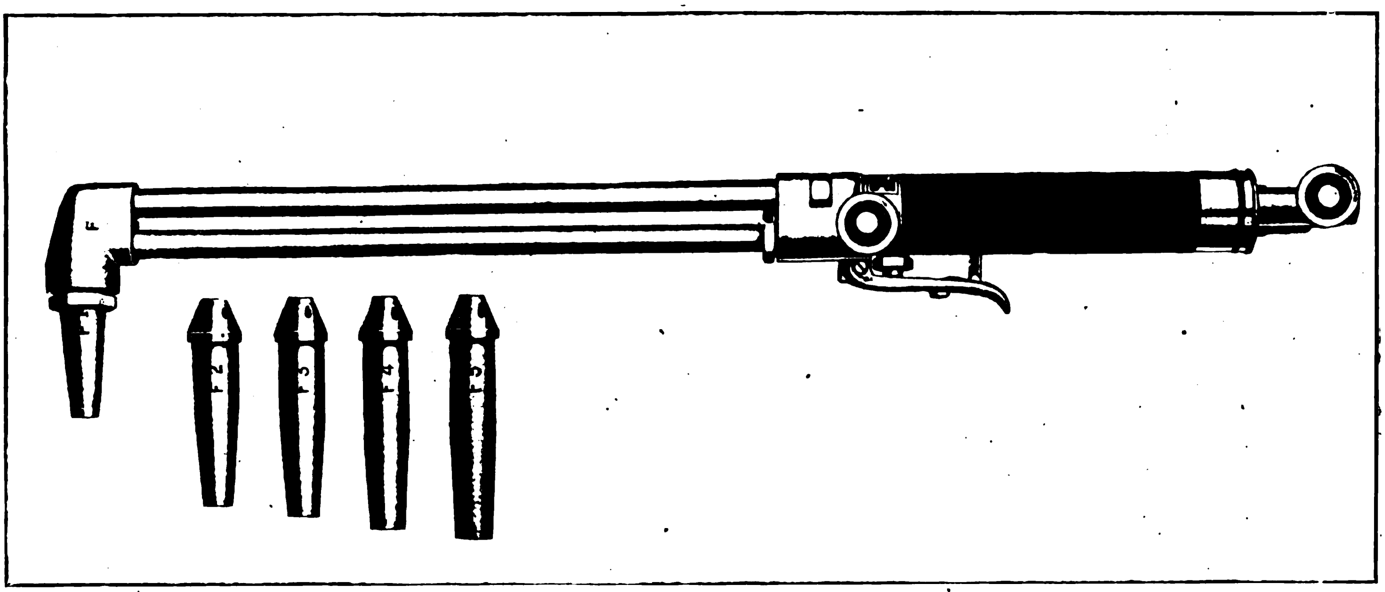
It is easy to operate. The staybolt is placed in the chuck *A*, and is centered in cup *B*. The cup is then thrown back out of the way by means of the arm *C*. Spherical seat jaws make it possible to chuck the square head no matter how irregular the forging.

The next operation is to engage the feed and turn the two ends simultaneously with the rear turner *D* and forward turner *E*. The forward turner will cut either straight or taper. The neck of the staybolt is cut with the tool *F*, after which the turning tools are thrown back out of the way.

The thread dies are engaged and the two ends of the bolt are threaded at the same time. The foreward die *G* will cut either straight or taper treads. The taper is generated by the use of the template *H*.

Cutting Torches with Mixing Chamber in the Handle

THE Purox Company, Denver, Colorado, has recently put on the market two styles of cutting torches which embody several interesting features. These torches, designated as styles E and F, will operate efficiently on oxygen, in combination with acetylene, hydrogen, or other combustible gases, and can be used for welding, as well as for cutting. The transformation to a welding torch is effected by means of a welding tip adapter, which cuts off the high-pressure oxygen flow. The drop forged front head, the tubes and the drop forged mixing chamber are made from Tobin bronze. The lever-latch, pawls, screws and valve parts are made from stainless steel.



Style F Purox Cutting Torch Weighing 60 Oz. and Having a Cutting Capacity of 24 In.

One of the special features of design is the location of the mixer at the front of the handle, remote from the heat at the tip, which insures safety in operation, constancy of pre-heating flame, and an easily operated, well balanced

torch. The front end tubes can be easily removed, which permits the use of special tubes of any required length and also the use of 45-deg., 60-deg., 75-deg., or 90-deg. head angles. The front end can be changed merely by unscrewing two nuts at the juncture of the handle and the front end. The mixer can also be changed quickly and easily in the same manner, to accommodate changes from oxy-acetylene to oxy-hydrogen or any other oxygen fuel combination.

Repairs to these torches can be easily made in the field by ordinary mechanics as they are assembled in units. As an example, the high pressure spring valve controlling the oxygen flow, together with its seat, can be removed and replaced as a unit with a tested spare part. It is equipped with a small diameter valve stem which tends to reduce the friction of movement and thereby permits an unobstructed gas flow. The small diameter allows effective packing against gas leakage. It is thoroughly protected against external strains, however, by a large diameter protecting cap which also acts as a housing for the valve spring.

The cutting oxygen lever is placed on the lower side of the torch handle so that it can be conveniently operated by the first and second fingers. It is provided with a latch which locks the valve depressed to any desired extent thus relieving the strain upon the operator. Merely touching this latch releases the lever immediately and stops the high pressure flow. An adjustment screw compensates for the lost motion. This construction gives positive operation.

The oxygen and fuel tubes in the handle are silver-soldered into the forging at the front end of the handle. The handle tube is merely a sheath and cap, through which the oxygen and fuel connections are screwed with straight threads to their tubes in the handle. The strain involved in connecting or disconnecting hoses is, therefore, not transmitted to the tubes and connecting parts but is taken through the locking device and the handle itself. To remove the fuel connections it is merely necessary to unscrew the lock. The high pressure oxygen valve, mixing chamber, and flame-oxygen valve are contained in a single drop-forged part, which greatly simplifies both assembly and repair.

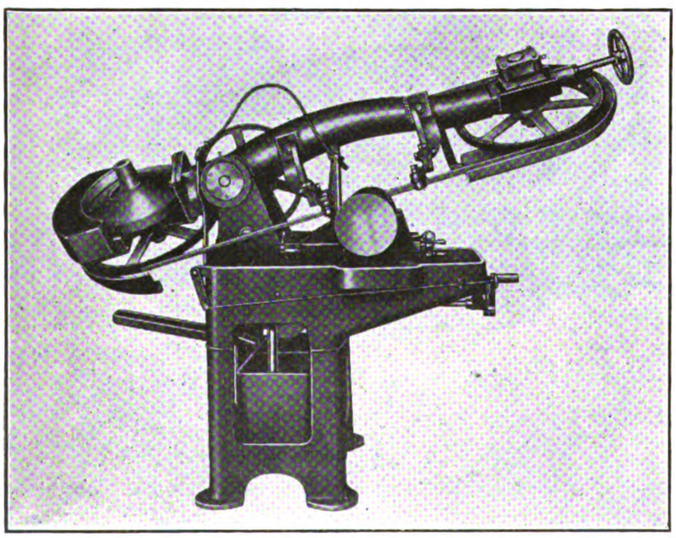
The flame-oxygen needle valve is provided with a round knurled wheel which is always under the operator's thumb, so that both the cutting oxygen and the flame are completely under the control of one hand, with the torch held in a natural position. The hose connections on these torches are on a horizontal plane instead of a vertical one, which reduces the drag of the hose on the operator's hand. The head is constructed with a female thread so that it is not easily damaged when the tip is not in place, the tip's retaining-nut having a male thread.

Styles E and F are 20 in. and 25 in. long, weight 46 oz. and 60 oz. and have a cutting capacity of 6 in. and 24 in. respectively.

Band Saw Which Cuts Solid Bars and Tubing at High Speed

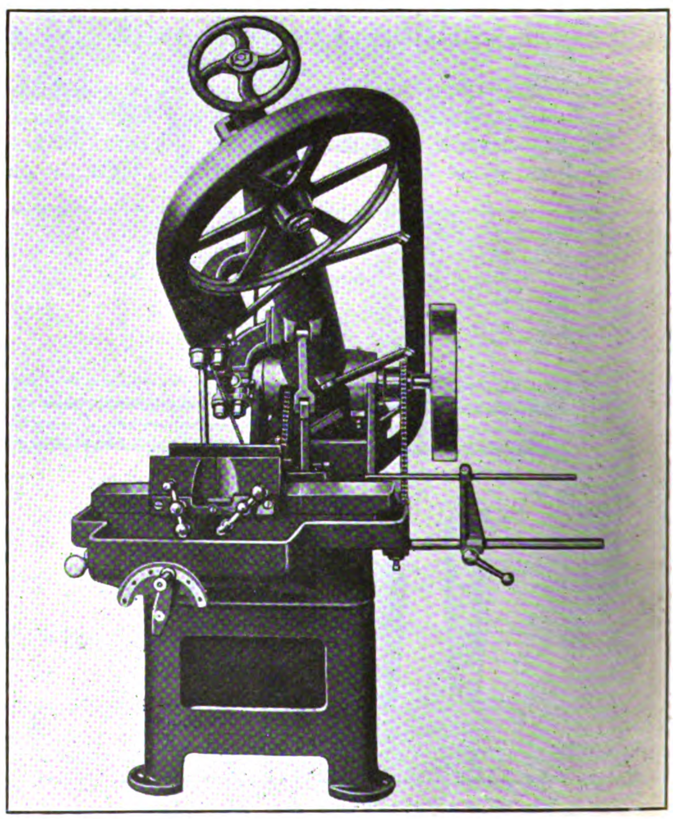
THE Henry G. Thompson & Son Company, New Haven, Conn. has developed a cutting-off machine of the horizontal band say type which is to be known by the trade name of Milband. It has several features not before applied to band saws for cutting metal, and is designed to cut stock of all sizes and shapes up to six inches.

A swinging frame carrying the band wheels is counterbalanced, so that there is no tendency for the saw to dig in because of soft spots or thin sections. The positive feeding movement is gear driven through a rack and pinion; is rigidly controlled, and the time of making a cut depends on the rate of feed for which the machine is set, which, of course, is determined by the size and nature of material being cut. By reason of this feature the same band saw blade, with five teeth per inch, cuts thin walled tubing with the same continuity of movements and rapidity as it cuts bar stock.



Metal-Cutting Machine Which Cuts at High Speed Material Ranging from Thin Tubing to Solid Bars of Annealed High Speed Steel and Monel Metal

There are six changes of feed speed, all controlled by a small crank lever to be seen in the front of the machine. An instruction plate permanently attached to the machine shows the correct feed setting for each grade of material and size of bar. As the machine is designed to cut anything from



End View of the Milband Metal Cutting-off Machine Showing Chain Drive and Speed Control Lever

thin tubing to solid bars of annealed high speed steel and Monel metal, a multi-speed countershaft is provided to change the lineal speed of the band in accordance with the nature of the material being cut. The feed and speed settings for all kinds of material and for various sizes of bar stock, by inches, from one to six, are shown on the instruction plate.

The main drive is through bevel and miter gears, having a reduction of 4 to 1 to the lower band wheel. From the first shaft power is taken off by chain and sprocket to drive the bank of spur gears, which, through the sliding key, controlled by the feed lever, determines the rate of feed for any given material. A second chain and sprocket drives a small centrifugal pump that supplies lubricant to the cut from a settling tank within the base of the machine.

The work holding vise is double and the jaws are independently controlled, so that the material to be cut is held firmly on both sides of the kerf. This feature permits the cutting of discs or slabs as thin as 1/8 in. without endangering the saw band or allowing the cut to creep sidewise. The band is guided both before and behind the cut by two pairs of hardened steel rollers mounted on ball bearings.

The feed is engaged and released by means of a pull-rod that terminates in a knob beside the feed control lever. When starting a cut, the operator pulls down the arm until the saw contacts with the work and then engages the feed clutch. The saw then cuts through the material at a continuous, definite rate established by the particular feed gears then in mesh, until the piece is cut off, when the feed disengages itself.

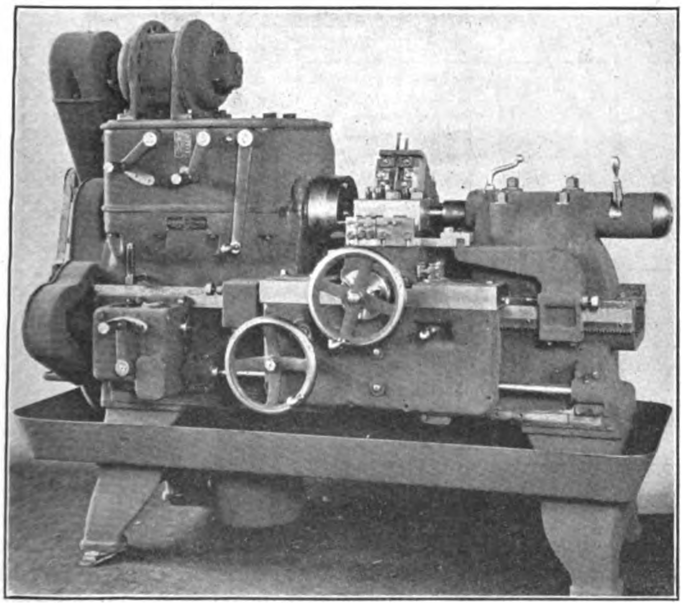
A special blade, produced by the manufacturer, is used. The band is 12 ft. 11 in. long, 3/4 in. wide, and .031 in. thick. The teeth are pitched five to the inch and are set to make a kerf .050 in. wide. The idle band wheel runs on ball bearings and is supported by a screw operated sliding block that is adjustable for the purpose of maintaining the tension on the band. The band is guarded on the idle side and around both wheels by a rigid aluminum guard that protects the operator from injury. A band can easily be changed by the operator without assistance.

The machine is designed to be driven by a 2-in. belt from an overhead countershaft, but if desired, a direct connected motor can be substituted. The motor bracket bolts to the rear of the base and a silent chain and sprocket are substituted for the belt and pulley. A variable speed motor can be used and the speed of the band determined from the control box, or changeable reduction gearing may be used in connection with a uniform speed motor. The machine requires about 2 h.p. to drive it. The floor space occupied by the belt driven machine is 6 ft. by 3 ft. 8 in., approximately 22 sq. ft., and weighs 1,050 lb.

Four Speed Production Lathe

A LATHE adapted for straight, taper and form turning, straight and bevel facing, recessing and straight and form boring has recently been added to its line of machine tools by the Reed-Prentice Company, Worcester, Mass. Its rugged construction permits a series of heavy cuts to be taken at one time, both with the front and rear tools.

The headstock is of box construction arranged with four



Reed-Prentice Lathe Arranged for a Herringbone Gear Connected Motor Drive

spindle speeds which are obtained through sliding gears positioned through crank handles conveniently located on the front of the headstock. The drive is through a disc clutch and brake located at the rear of the head and operated by a hand lever at the front of the headstock. This arrangement of levers provides for simple manipulation, while the disc clutch and brake give instantaneous starting and stopping.

The headstock can be furnished with either belt or motor drive. The illustration shows it arranged for herring-bone gear connected motor drive with all gears running on ball bearings. The motors used range from 5 hp. to 20 hp., depending upon the class of work.

All of the headstock gears are of hardened steel and the driving gears to the spindle are of the herring-bone type to provide a smooth power transmission. All of the gear shafts in the headstock, with the exception of the spindle, run in ball bearings, while the spindle journals are hardened and ground and run in bronze bearings.

The cam tailstock provides for quick withdrawal of the tail center as well as a fine adjustment of the center in the work. This provides for quick loading, and a hand clamp locks the tail spindle when the machine is in operation.

The carriage is extra heavy throughout, and the carriage bridge is supported on a right angle bearing inside of the bed, directly under the front tool holder. The apron is arranged with independent power longitudinal and cross feeds, either of which may be engaged separately. Both the longitudinal and cross feeds are automatically operated and tripped in both directions, the direction of the feed being determined by the position of the hand lever projecting from the front of the apron. The changing from longitudinal to cross feed, and vice versa, is obtained by a pull gear controlled from a handle protruding from the front of the apron. The operation of the automatic trips is simple and dependable, and with the use of positive bed and cross stops, very accurate positioning of the tools may be obtained.

Both the rack pinion and cross feed hand wheels are large in diameter, while the latter is arranged with a large micrometer dial.

The feed box regularly furnished gives four feeds, and by compounding the standard gears constituting the end works, three additional feeds may be obtained. The changing of the feed in the gear box is accomplished through

sliding hardened steel gears operated by a crank handle at the front of the box.

The facing and chamfering operations are obtained through the use of a Reed-Prentice patented back arm attachment provided with sensitive worm adjustment for the relationing of the tools to the work. This attachment is sturdy in construction, and has a long angular support bearing on the lower part of the bed.

The entire headstock is lubricated through a splash system, and the sight feed oiler shows the level of the oil at all times. All apron bearings are oiled from pipe connections to an oiler at the top of the carriage, while the feed box bearings are lubricated from pipe connections to the top of the box. Other bearings are arranged with oil cups conveniently located.

Various sizes and types of tool holders and drivers can be furnished to suit the large variety of work for which the machine is adapted.

The Street Locomotive Starter

A LOCOMOTIVE starting device has recently been dedeveloped by Clement F. Street, Greenwich, Conn., which is the result of four years of experimental work, during which time nine machines were built and tested. Referring to Fig. 1, the device consists essentially of two cylinders which are arranged parallel to each other, with their pistons and connecting rods. The outer end of each connecting rod is secured by a pin to a pair of swinging arms carried on the axle. Between each pair of swinging arms is a ratchet wheel pressed and keyed to the axle, and a ratchet is pivoted to each pair of arms, as shown in Fig. 2. This ratchet is held out of contact with the ratchet wheel by a spring. The cylinder casting has two bearings formed on the front end, outside of the arms, to carry the weight of the front end of the starter. The back end is carried by means of a flexible support to the truck frame. This method of carrying the cylinders is similar to that used in supporting street railway motors.

Steam is admitted to one end of the cylinders only and consequently the back end of the connecting rod is pivoted directly in the piston which makes possible a short, light construction. Owing to the use of this trunk type of cylinder, only one valve is used and this is placed in the rear cylinder head. This is of the plain piston type. It is thrown by steam pressure and has no mechanical connection with other movable parts of the starter. A nest of flat circular springs in the valve chest head furnishes a cushion for the valve to strike against at each end of its stroke.

The novel feature of the motor is the method of coupling together the two pistons by a cross lever pivoted to the cylinder casting, so that when one piston is driven forward by the steam pressure it pulls the other piston back. The stroke of the piston when working is about 8 inches. Just before the piston reaches the outer end of its power stroke, it uncovers a port in the cylinder and admits steam through the valve chest head to one end of the valve which reverses its position. This cylinder is thereby opened to the exhaust and steam is admitted to the other cylinder. This operation is continuous as long as there is steam pressure in the valve chamber.

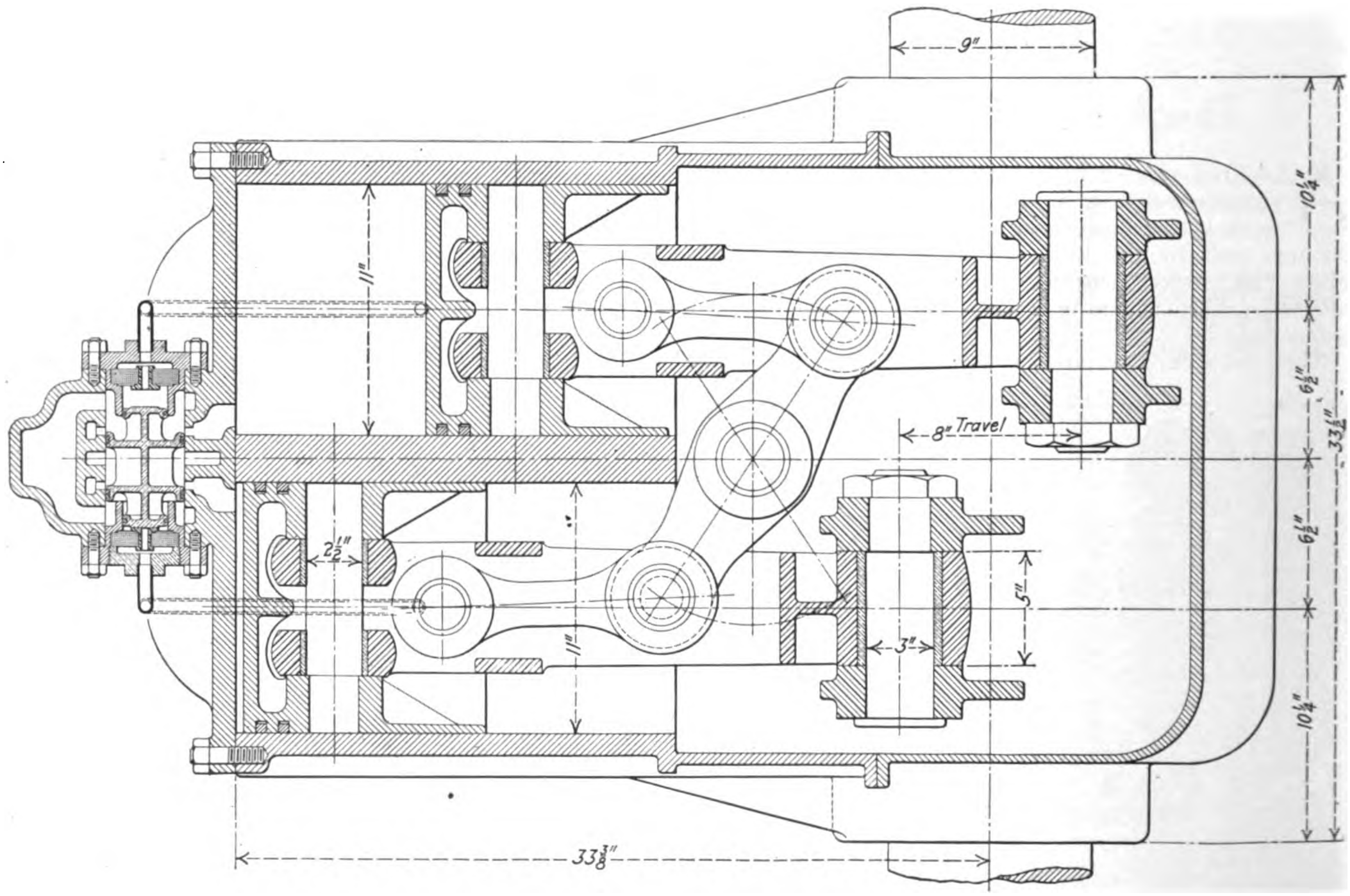


Fig. 1—Drawing Showing the Arrangement of the Cylinders and Piston Rods

The two cylinders with the valve, their pistons and cross lever connection make an operative machine which will run with the connecting rods disconnected. The cross connection between the piston, with the absence of cranks and fly wheels, eliminates the need for a governor as the motor cannot run beyond a speed of 150 strokes per min. Owing to the absence of cranks, the pistons must be reversed at the end of their stroke by a steam cushion and a balancing speed is reached when the time required for stopping the pistons and starting them in the opposite direction, after the valve has been reversed, becomes equal to the time required for their long travel between port openings. An increase in the weight of the moving parts would reduce this maximum speed and a reduction in their weight would increase it somewhat.

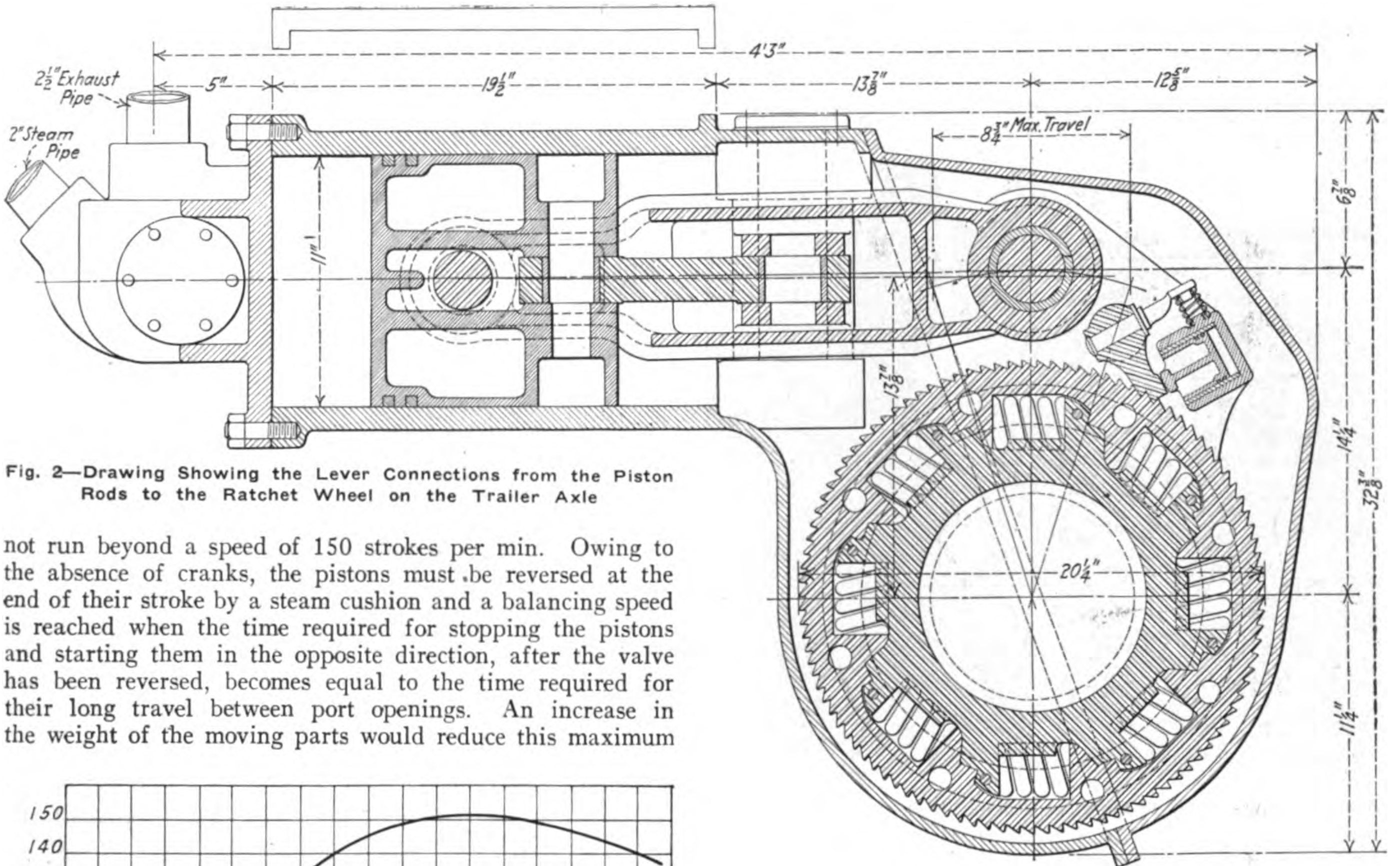


Fig. 2—Drawing Showing the Lever Connections from the Piston Rods to the Ratchet Wheel on the Trailer Axle

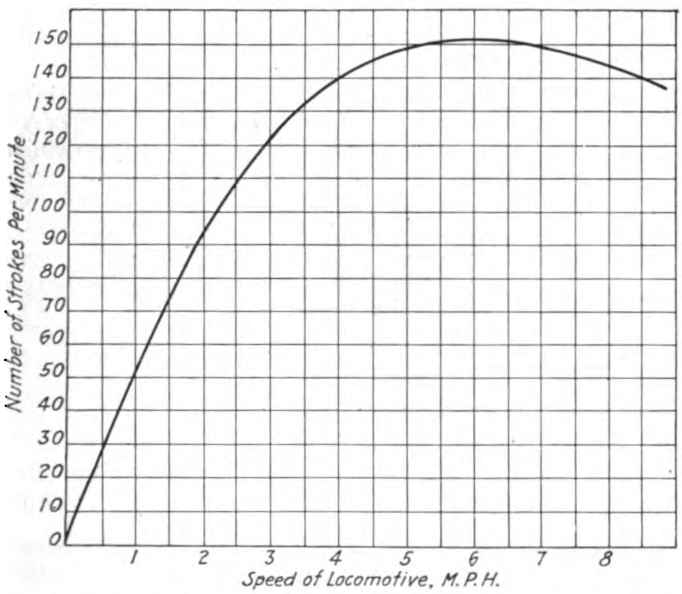
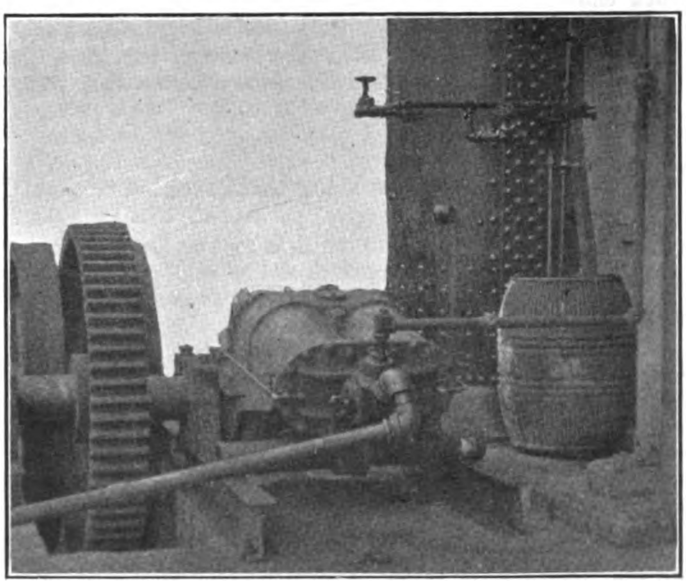


Fig. 3—Curve Showing the Relation Between Strokes and Speed

Fig. 3 shows the results of a series of tests made to determine the maximum speed at which the locomotive could be run with the greatest number of working strokes of the starter. It was found that after six miles per hour the number of strokes began to decrease. This feature in the starter's operation shows that its greatest service is performed at slow speeds and it can be automatically cut off at six miles per hour.

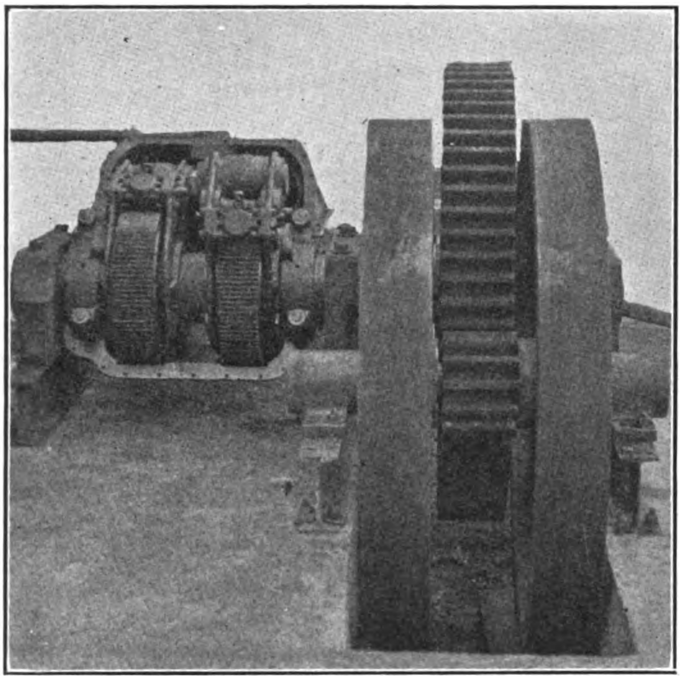
The ratchets are normally held out of contact with the ratchet wheel by springs. Steam pressure, when admitted to the cylinder, is also admitted to a small cylinder above the ratchet for that cylinder and forces it down in contact with the wheel. It remains in this position as long as there is pressure in the main cylinder. When the pressure in the main cylinder is reduced to exhaust, the pressure is also reduced in the ratchet cylinder and the spring lifts the ratchet clear of the wheel. The machine is thus always ready for action, with no preliminary throwing of clutches or shifting of gears. When the steam pressure is cut off from the starter the parts come to rest in whatever position they may be in, except that the ratchet spring will lift the ratchet clear of



A Front View of the Locomotive Starter Attached to a Stationary Boiler for Testing Purposes

the ratchet wheel, and they are ready to resume operation as soon as the steam is turned on again.

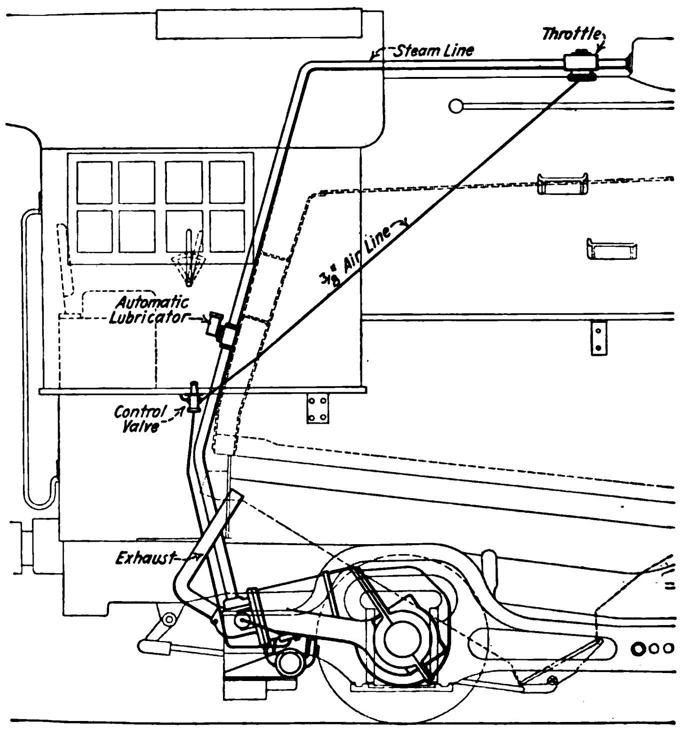
All of the parts of the locomotive starter are easy of access and may be inspected without removing the device from the locomotive. The valve chest heads may be taken off and the valve removed without disconnecting the steam or exhaust pipes or disturbing any other part of the starter. In order to inspect or remove the ratchet and its attachment the locomotive can be run over a roundhouse pit and the



A Rear View of the Locomotive Starter While Undergoing Tests

back end of the machine lowered until it hangs entirely on the axle. In this position the front cover can be removed and all of the parts on the axle exposed. The support for the back end of the starter is made with a removable section which can be taken out in case it is desired to lower the back end.

The work to be done by the ratchet is heavier than that which is usually required of such a device, but there are at present in use machines which have ratchets that carry loads almost as heavy. In many cases these are running constantly, while the starter is run only for short periods. The ratchet wheel is fitted with a series of coiled springs which cushion the action of the ratchet when it comes in



Drawing Showing the Application of the Starter to a Locomotive

contact with the wheel. The life of both the ratchet and wheel will depend largely on the material from which they are made, and both are designed so that they can be made of a high grade of forged steel.

The construction of the control mechanism has been simplified by the use of the smallest possible number of parts. It consists of an engineman's foot valve which operates the throttle. As long as the engineman's foot is on this valve the throttle remains open and when the foot valve is released the throttle closes automatically. If desirable, a small air pump which has been designed for this purpose can be applied for closing the foot valve when the starter has reached a predetermined speed.

An Automatic Lathe with Two Carriages

An automatic lathe with multiple tooling for performing turning and facing operations has been placed on the market under the trade name "Duomatic" by the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. This machine is adapted for the quantity production of lathe work, whether held between centers, on an arbor, or in suitable fixtures. The cycle of operation is completely automatic, including the control of diameters and the lengths on the work. The proper dimensions are obtained by means of positive metal-to-metal stops which insure a high degree of accuracy.

As its name implies, the Duomatic is dual in character, having two carriages equipped with tool slides. Each of these units has an independent power quick forward and return traverse, as well as a power feed to both the carriage and the tool slide. As a result, both carriages can be used simultaneously, or, as is usually the case, one carriage with its tool slide can be utilized in a turning operation, while the other is being used in a facing and fileting operation. The dual construction, combined with the simple method of adjusting for the various functions, makes the machine

Automatic Lathe Having Two Carriages Equipped with Tool Slides

adaptable for a variety of work without the use of special attachments or parts. The rotation of the feed screw gives the cross movement to the tool slide and the longitudinal movement to the carriage. An adjustable threaded micrometer sleeve arrests the movement of the cross slide to fix the diameters of the work and the adjustment of a pair of nuts on a threaded stop bar limits the movement of the carriage in either direction.

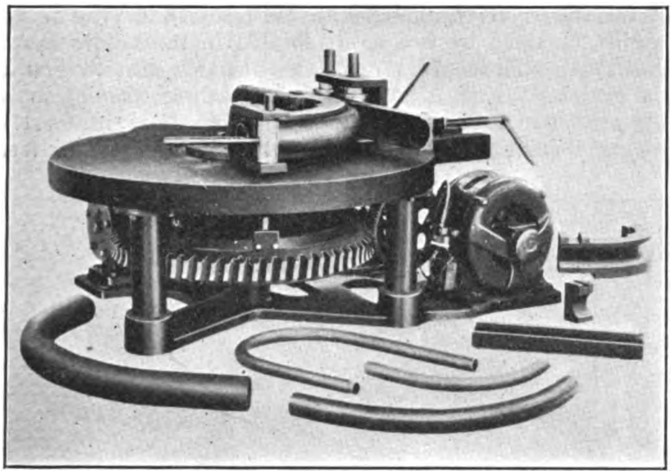
The single pulley drive with its multiple plate clutch is said to transmit unusual power to the main spindle of the headstock. The shafts carrying the gears of this drive are mounted in ball bearings. The bed, carriages and tool slides are designed to take the cutting strains without vibration and chatter, thus increasing the life of the cutting tools. Hardened alloy steel parts have been used liberally to obtain a substantial construction and large bearing surfaces on the carriages and tool slides insure long life and relative freedom from adjustment. The headstock and the clutch mechanism, as well as the feed and power traverse mechanism, are enclosed and automatically lubricated.

Portable Power Driven Bending Machine

A POWER driven bending machine for handling pipe, reinforcement bars, square bars, round bars, angles, channels and tees has recently been placed on the market by the Wallace Supplies Manufacturing Company, Chicago. It covers a wide range of work and at the same time is sufficiently light to make it reasonably easy to transport by means of a truck from one job to another.

The machine operates in both directions, and is, therefore, suitable for making both right-hand and left-hand bends in reinforcement bars, which is a decided advantage in the bending of material of this kind. This, however, applies only to bars, as pipes, angles, channels, tees, etc., on account of the tool equipment necessary for bending such shapes, can be bent only to the one hand and in order to get a reverse bend the material has to be removed and reinserted from the opposite end.

It is equipped with a form for making a 90 deg. bend in a 4-in. diameter pipe, but more than 90 deg. bends can be obtained either by resetting the material in the form and putting it through repeated operations, or by having the machine equipped with a special form to suit the number of degrees of bend wanted.



Portable Power Driven Bending Machine Which Handles a Wide Range of Work

The form is secured to the head of the machine and, therefore, becomes a rotating member in its operation. One end of the pipe to be bent is clamped to the form, which is accomplished by the use of an eccentric lever, which has its bearing against a floating block shaped to fit the pipe. This admits of easily slipping the pipe out of the clamp when the bend has been completed. In the case of a reverse bend, the fulcrum pin with the knurled top, which secures the eccentric to the clamp, is taken out in order to remove the finished S bend.

Forms can be furnished according to the specifications to make bends of any number of degrees to any radius, from a minimum of a 4-in. radius in pipe as small as 1¼-in. iron pipe size, to a maximum of 24-in. radius in pipe as large as 4-in. iron pipe size. It is also possible to increase the radius to 36 in. by altering the patterns with special attachments.

A floating follower bar is interposed between the form and the back pressure rollers to support the walls of the pipe at the point of bending and to prevent the flattening of the pipe by any direct pressure of the rollers against the wall of the pipe. The follower bar is accurately grooved to fit the pipe. The back pressure rollers are held in position by pins with extended knurled ends, which allows the rollers to be easily removed for the purpose of quickly changing over to another type of roller for special jobs when necessary.

The back pressure rollers are mounted on a movable bracket in a tapered extension slide, and can be easily moved backward and forward within a range of 24 in. to make them quickly adjustable to suit forms of various sizes of follower bars, or other tool equipment that may be needed for the bending of angles, tees, channels or special sections.

In addition to the screw adjustment, the adjusting screw nut, in which the adjusting screw operates, is fitted with two pins. The tapered slide is arranged with a series of holes so that the entire adjusting screw mechanism can be quickly moved backward and forward, and at the same time permit the placing of the nut as closely to the bracket as possible in order that it may be held rigidly.

At approximately the center of the main worm gear will be noticed a movable stop block, held in position by two set screws. This block serves as a knock-out for the clutch mechanism and can be set at any predetermined point on the flange of the large worm gear automatically to stop the machine to correspond with the number of degrees of bend that may be required. For the bending of pipes 2½ in. in diameter and under, the machine should be operated directly through the regular worm gear, which develops enough power to bend up to this size of pipe, but if pipes over 2½ in. and up to and including 4-in. iron pipe size are to be bent, the work should be done through the back gears with which this machine is equipped. The lever for throwing the back gears into service is shown at the right of the machine. Under the direct drive through the worm gear the head revolves at a speed of 4½ r.p.m., while when operating through the back gears the speed is reduced to 1¼ r.p.m.

The machine can be operated forward or reverse, and also stopped at any point by means of a lever which operates the clutch fingers of the double cone clutch mechanism. Thorough lubrication is effected by oil tubes leading to all important bearings. The worm and worm gear are enclosed so that they will run in gear grease. The floor area required is about 6½ ft. by 6 ft., and the height of the machine from the top of the floor to the top of the table is about 26 in., while the height over all is approximately 36 in.

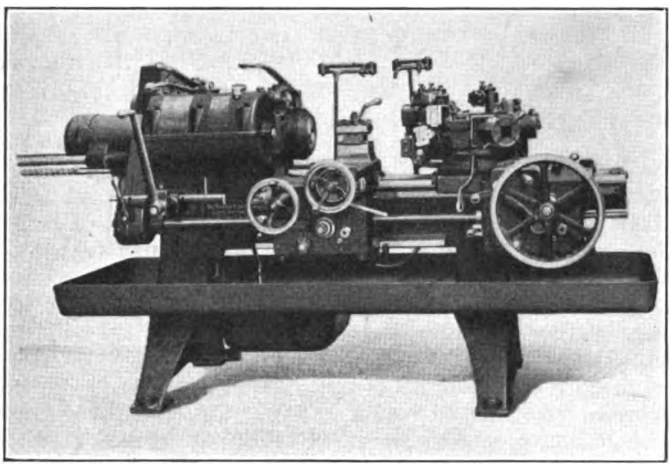
A Universal Hollow Hexagon Turret Lathe of High Capacity

THE Warner & Swasey Company, Cleveland, Ohio, have recently placed on the market what is known as its No. 1-A universal hollow hexagon turret lathe. While similar in general type to the No. 2-A and 3-A turret lathes, this machine incorporates many improved features. It has a new design of all-steel geared head, an increased number and range of feeds, a quick method of changing feeds in the aprons of the carriages, a new patented turret binding mechanism, and new tooling.

The machine equipped for bar work is shown in the illustration. Its capacity through the automatic chuck collet is 2½ in. for round bars, with a maximum turning length of 26 in. The machine may also be equipped with a 12-in. chuck, giving a maximum swing over the carriage of 13¾ in. and over the ways of 16¾ in.

The machine is designed with the changes of feeds located in the aprons, eliminating unnecessary effort. The gears in the head are controlled by easily operated levers, reached conveniently from the position of the operator. The power rapid traverse greatly reduces the fatigue attending the hand movement of the loaded turret.

The head of the machine is cast integral with the bed



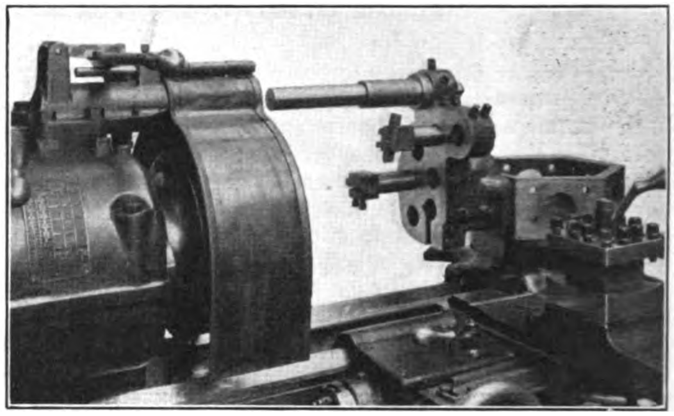
Warner & Swasey Universal Turret Lathe Equipped for Bar Work

which assures the rigidity of this member. The gears shown in one of the illustrations are substantial in proportions, are made of heat-treated steel and operate in an oil bath. The system of gearing provides 12 spindle speeds, both forward and reverse, running from 20 r.p.m. to 477 r.p.m. The wide selection of speeds is particularly useful where large and small diameters are to be turned, bored, or threaded on the same piece. Starting, stopping, and reversing the machine is accomplished through a double friction clutch on the back shaft of the machine.

Provision has been made for two arrangements of the motor drive. A motor may be mounted on the head end leg, and connected by a belt with the single pulley drive. This arrangement is furnished standard where the countershaft is omitted. Where it is required to keep within the floor space occupied by the machine itself, the motor may be mounted on the plate on the head of the machine and connected by a chain with the driving pulley.

The hollow hexagon turret is used, with broad faces to which tools and holders are bolted from the inside. This form of turret assures solid support for the tooling, and permits the use of heavy multiple cutting tools, taking several cuts at the same time. To assure accuracy of alinement, the faces of the turret are faced and bored by tools held in the spindle of the machine itself, after final installation of the turret.

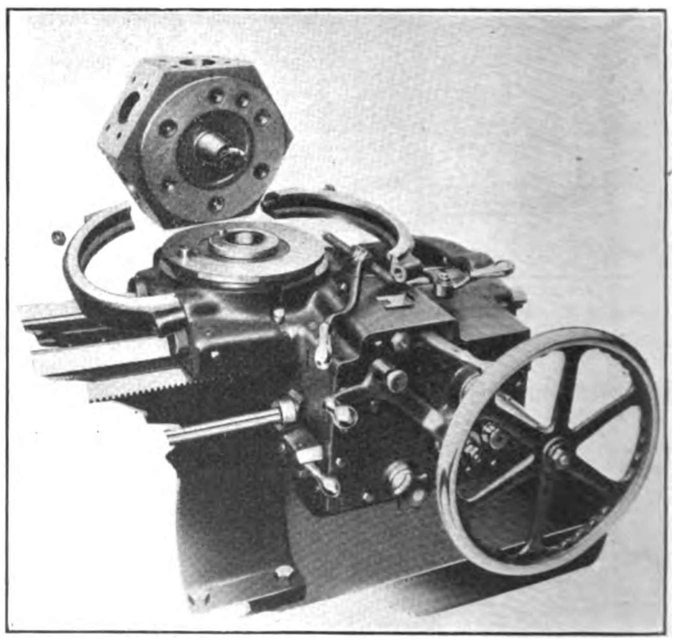
To secure rigidity of the turret under the increased feed pressure encountered in this machine, a unique patented binding mechanism has been designed. As shown in the illustration, it consists of a two-part collar with a groove of tapered section which embraces a tapered flange on the bottom of the turret and a tapered flange on the turret seat. By means of right- and left-hand screws, manipulated by a lever, the two halves of this collar are pulled together and



Turning Head with Overhead Pilot Bar

the turret bound tightly to its seat. The same lever operates the turret lockbolt.

The turret is equipped with 16 feeds, 8 of which are readily obtained by two levers located in the saddle apron itself. An additional lever operates a change gear located in the gear box at the head end of the machine, thereby making available a selection of 16 feeds from .0045 in. to .120 in. per revolution of the spindle. The location of the feed



Construction of the Turret Binding Mechanism

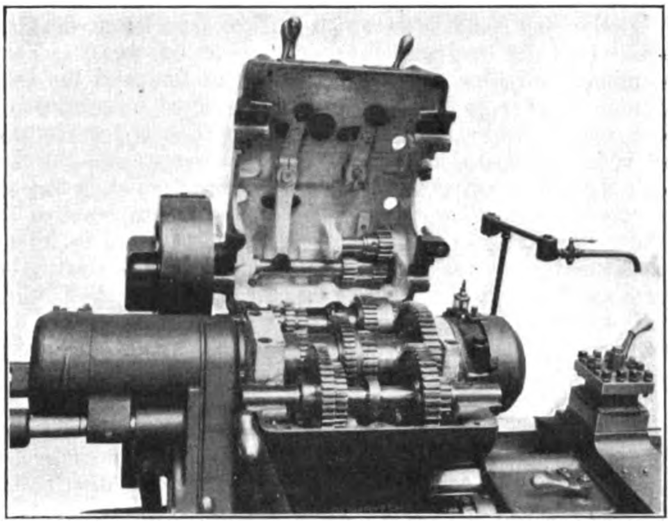
changes in the saddle apron substantially reduces the time of changing. A rapid power traverse has been provided for moving the turret to and from the working position in order

to lessen the operating effort. It can not be engaged while the turret is under feed and will automatically disengage as the turret reaches the end of the bed.

The side carriage is mounted on the front vee, and does not extend across the ways. It is gibbed to a lower dovetailed bearing on the front of the bed. This construction gives a firm support to the side carriage and provides a valuable clearance. The swing over the end of the cross slide dovetail ways is 13¾ in., and over the carriage the swing is 16 in. The entire side carriage may be moved to the left past the chuck and out of the way of the turret saddle when not in use. This gives a maximum swing over the ways of the bed of 16¾ in. The square turret is mounted on the side carriage and will hold four or more tools. It is indexed without being lifted from its seat, and may be clamped in any position by a quarter turn of the binder head.

Sixteen longitudinal and 16 cross feeds are provided for the side carriage, which may be operated independently of the turret carriage. With this wide range of feeds peripheral turning, cross facing, or recessing operations may be performed by the square turret tools at the correct feed, while the hexagon turret is engaged in drilling, boring or turning cuts at the proper feed. The cross travel of the square turret is 8¼ in. The longitudinal travel of the side carriage is 22¾ in., which may be extended to a maximum of 30½ in. by removing two of the dogs on the stop roll.

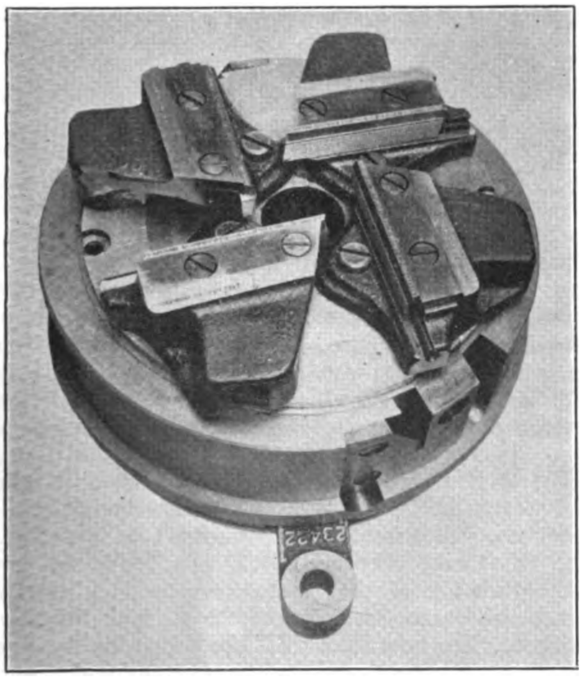
The standard equipment for both bar and chucking work is complete and flexible, so that it may be adapted to a wide range of production requirements without the use of special tools. An overhead piloted turning tool is a standard accessory of this machine. The pilot bar is held adjustably in the body of the turning head, and enters a corresponding bushing adjustably mounted on the head of the machine. The design compensates for the loss of a center pilot bar when the latter can not be used, and greatly increases the rigidity of the machine and tools on extremely heavy work where both center and overhead pilots may be employed.



Heat Treated Steel Gears Operate in an Oil Bath in the Head of the Machine

Reverse Die Head for Cutting Taper Threads on Crown Bolts

THE Landis Machine Company, Waynesboro, Penna., has placed on the market a reverse taper die head for cutting tapered threads on crown bolts from the big end to the small end. When cutting these threads the usual practice is to thread from the small end to the large end. This usually causes the nicking of the body of the bolt, which makes the bolt unfit for service, or at least creates a tendency for the bolt to break at the place where it is nicked during the threading operation. The Landis die head was designed to overcome this condition.



Reverse Taper Die Head for Cutting Threads on Crown Bolts, Threading from the Large to the Small End

Another important feature is that the square on the end of the crown bolt does not have to be true with the body for the die head grips the body of the bolt. The die head is furnished in the 1½-in. size only. Its diameter is 11⅞ in. and its length is 7 5/16 in. The maximum diameter of the bolt which can be threaded is 1⅞ in., while the maximum taper of thread is 2 in. per foot. The head can be applied to any Landis threading machine having a capacity of 1½ in. or more. The machine must be equipped with a lead screw attachment to insure a thread of perfect form and correct lead. A special carriage front or trip rod brackets will be required to accommodate the two trip rods which are supplied with the head.

The die head is operated by two trip rods attached to the carriage in front of the machine. These rods are fitted with adjustable nuts which engage the lugs of the yoke ring. The lugs are located diametrically opposite each other. The adjustable nuts are placed in contact with the lugs on the yoke ring when the work is about to enter the die head. As the work advances, the yoke ring is pushed back, taking with it the operating ring to which the cam shoes are attached. The cams are designed so that, as the cam shoes slide over the cams, the die head is closed gradually to correspond to the taper of the thread. A set of cams is required for each thread taper.

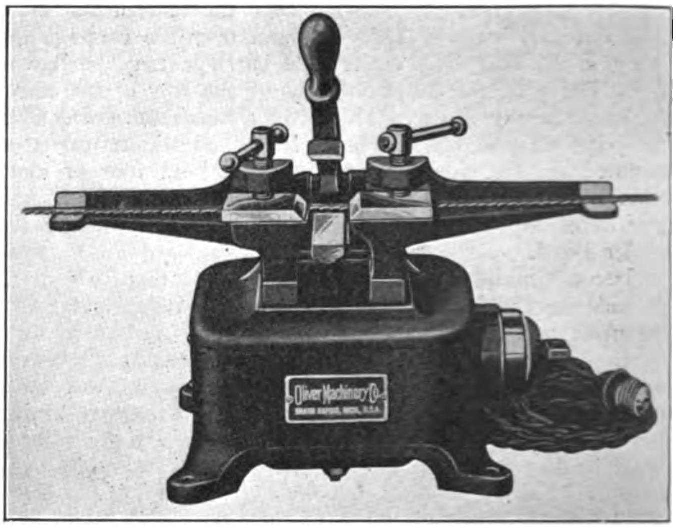
The travel of the cam shoes must equal the length of the thread. The die head opens when the crest of the cam shoe passes the crest of the cam. Stop screws are provided to limit the opening of the head which is automatically brought to the threading position as the carriage is withdrawn from the work.

Electric Brazer for Band Saw Blades

THE Oliver Machinery Company, Grand Rapids, Mich., has recently put on the market a device for brazing band saws which utilizes the electric heat of resistances for melting down the soldering metal. This eliminates any open flame, the danger of fire, and the formation of scale on the saw blade is prevented by a sensitive control of the heat. The device comprises a transformer of which the main coil is connected to a power or light circuit through a switch, and a secondary coil which serves as a stay for both saw ends. The saw ends are bevelled to about 1/8 in. to 1/2 in. Then a strip of 1/2-in. to 3/4-in. silver solder is laid between them and the apparatus is started by turning the switch. After some seconds the brazed seam will glow and melt down the brazing metal. Besides the zero position the switch has three further steps. By every step certain windings of the secondary coil are switched in and off thus causing a stronger or a less intense heat. The switch can be regulated both backward and forward thus permitting of regulating the heat conduction during the melting period. After this, the brazing metal is distributed on both sides by means of a borax flux so as to obtain a tight connection and a clean brazed seam without any scale which is a desirable feature.

By means of the hawkbill, both saw ends to be brazed are firmly pressed together for some seconds after the brazing metal has been melted down, but this should only be done after the current has been switched off. There is no annealing of the saw blade. Too great hardness of the steel is prevented by again switching on the electric current.

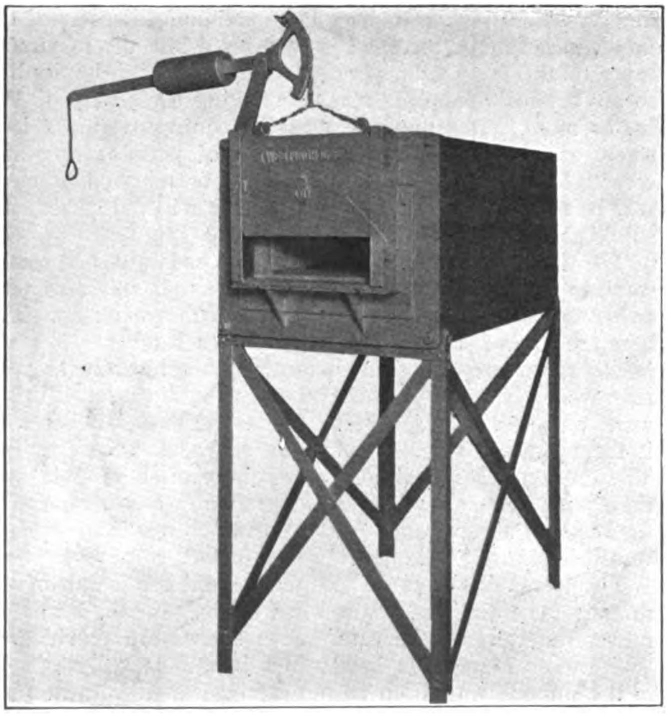
The brazing process can be easily supervised by the workman, as no flames or dangerous temperatures are produced and damage to the apparatus by wrong attendance is excluded. It requires from six to twelve amperes for blades up to a width of two inches so that it can be connected to every alternating current feeder.



Oliver Electric Brazer Which Can Be Used by Unskilled Workmen

Industrial Electric Furnace with Perforated Muffle Plates

A NEW industrial hearth-type electric furnace for operation up to 1,850 deg. F. has been recently perfected by the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. These furnaces, which are known as type B, are made with hearth sizes ranging from 4 in. wide and 10¼ in. deep to 12 in. wide and 36 in. deep and are particularly well suited for such operations as annealing, hardening, tempering, normalizing, carbonizing and case hardening. Automatic temperature control makes it possible to duplicate heating conditions as often as is necessary.


Electric Furnace Equipped with an Automatic Temperature Control

One of the distinctive features of this furnace is that the muffle plates, which completely enclose the heating chamber, are perforated so that heat is radiated directly from the heating element to the charge. This unusual construction permits a higher temperature in the heating chamber without undue deterioration of the heating elements. These elements, which consist of S-bend coils of nickel-chromium wire, are placed on all four sides of the heating chamber and are supported and alined by molded studs on the muffle plates.

The door of the furnace is suspended by a chain from one point, which, being always on the circumference of an arc at the end of the operating handle, maintains a position directly over the center of the door when it is opened or closed. This method of operation prevents the door from sticking or jamming in its guides. Pieces of angle iron bolted to the guides are so adjusted that the door is held closely against the front casting when closed but can move easily when being opened.

The insulation of the furnace is arranged so that the muffle plates do not carry any of the weight. Standard insulating bricks next to the shell are supported by the high temperature insulation, which is in the form of slabs. In this way, the muffles are relieved of the weight of the insulation.

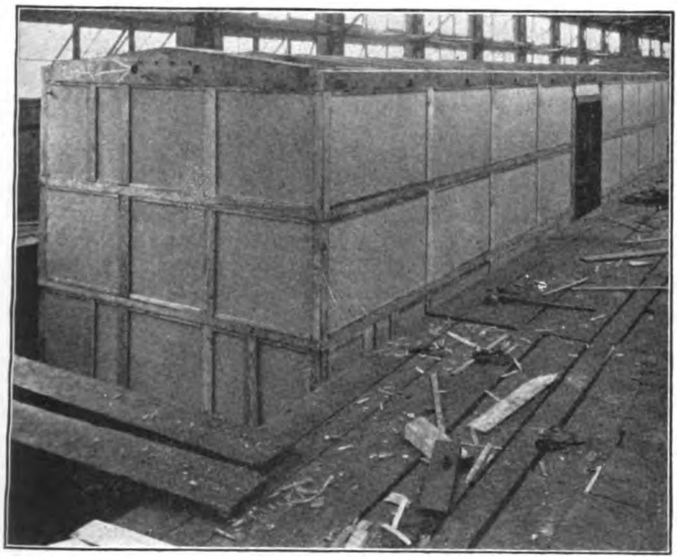
The furnace shell, or casing, is of heavy sheet steel, with the sides and bottom in one piece. The top, however, is a separate piece, to facilitate removal for the purpose of mak-

ing repairs to the insulation or heating element. The rear casting design is a frame supporting an asbestos panel through which the ends of the heating coil protrude. Heavy air cooled connectors join the coils in series and connect to the lines.

One of the advantages of the electric furnace is its automatic control, enabling the operator to maintain a desired temperature indefinitely. The automatic electric control consists of a control pyrometer, a relay and magnetic contractor. In the control instrument, a stationary pointer carrying two electric contacts is set at the desired temperature and the furnace turned on by a conveniently located push button. As the temperature rises, an indicating hand in the control instrument, actuated by a thermo-couple in the furnace chamber, moves along the scale. When it reaches the upper of the two contacts carried by the stationary pointer, the relay is energized, opening the magnetic contactors and cutting off the current. When the temperature falls to the point where the indicating hand reaches the lower of the contacts on the stationary pointer, the relay cuts the current on again. This cycle, continuing as long as the furnace is in operation, maintains the temperature within approximately one per cent of the desired point without any attention on the part of the operator.

Insulating Lumber for Refrigerator Cars

A NEW insulating lumber, known as Celotex and developed by the Celotex Company, Chicago, is adapted to use in the building trades as sheathing, exterior finish, plaster base and roof insulation. Celotex of lighter density is also being introduced extensively in the railroad field, particularly as the insulating medium in refrigerator cars and steel cars. The adaptability and success of the material for this purpose is shown by the fact that about 20 million sq. ft. is now in use in refrigerator cars owned by six railroads and eight car companies.



Side Walls and Ends Insulated with Four Layers of Celotex

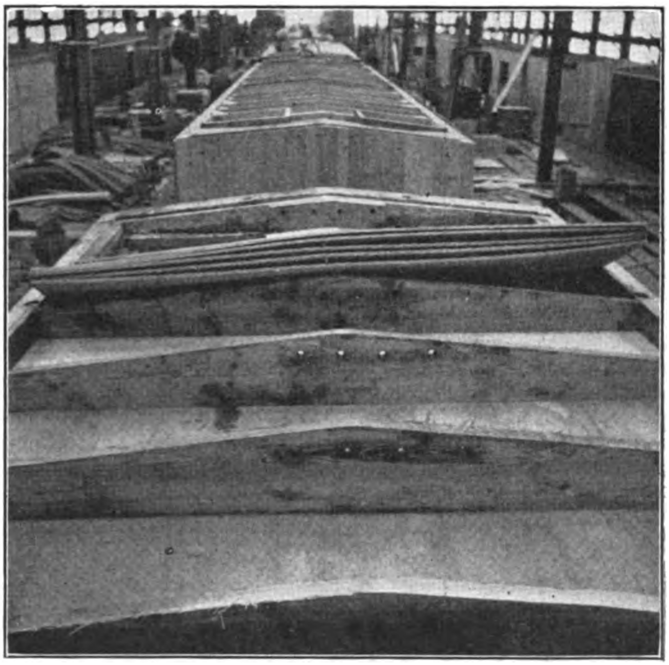
Celotex is an insulating lumber made from sugar cane fibre or bagasse, as it is called in the South. During the course of manufacture the cane fibre is firmly interlaced and felted into a strong insulating board. The strength of the material is derived solely from its structure as it does not contain any adhesive. The material comes in sheets ½ in. thick and of any size to meet the car builder's specifications.

The tensile strength of Celotex is 373 lb. per sq. in., and a board 12 in. wide, with supports 16 in. apart, will deflect 13/16 of an inch under a load of 158 lb. Tested as a sheathing material applied to studs, in comparison with ¾ in. by 6 in. yellow pine boards, Celotex shows six times as much resistance at the point of initial deflection, and nearly twice as much load at the point of failure. Heat transmission tests at the Armour Institute of Technology by the flat plate method are indicative of the insulating quality of the material. These tests are reported to have shown a conductivity of 7.91 for Celotex as compared to 7.4 for pure corkboard, 8.3 for rock cork, 10.4 for pulp board and 19 for white pine. In other words, Celotex has roughly three times the insulation value of white pine. It weighs 13 lb. per cu. ft. or only one-third as much.

When used in refrigerator cars Celotex performs two functions, providing insulation and taking the place of the blind lining. It is applied directly on the car frame and all blind lumber is omitted. The index figure 7.91 means that only .33 B.t.u.'s per sq. ft. per in. thickness per deg. F. difference in temperature will be transmitted through Celotex in one hour. Any number of layers may be applied to build up the insulation value which the car builder desires.

Celotex may be used as the sole insulating material or in combination with other materials. It is designed to be highly resistant to moisture so that it will not deteriorate even under water pressure. It is thoroughly waterproofed during the process of manufacture, assuring the maintenance of maximum efficiency in insulation during the life of the car.

An advantage of Celotex when used as floor insulation is the possibility of arranging the material in laminated layers one over the other, avoiding continuous joints in the floor. Further advantages of Celotex are its ease and consequent low cost of application. No special tools are required as it can be sawed like lumber.



Celotex Used for Roof; Also Floor Insulation

GENERAL NEWS

The Supreme Court of the United States on October 27 again refused to review the case of former employees of the Atchison, Topeka & Santa Fe who were convicted of criminal conspiracy to obstruct the mails and interfere with interstate commerce after having suddenly gone on strike at Needles, Calif., at the time of the shopmen's strike in 1922, leaving passengers stranded in extremely hot weather. On October 13 the court had declined to review the case, but an application was filed for a reconsideration.

Simplification of Steel Lockers

Following an extended study of the sizes and varieties of steel lockers and as a sequel to a meeting of manufacturers held in February, 1923, the Division of Simplified Practice of the Department of Commerce, Washington, will hold a conference of manufacturers, distributers and users of this equipment on November 19 to consider the elimination of excess varieties. The tentative recommendations for the standard sizes to be retained provide for three widths, four depths and four heights. The practicability of including compartment and multiple tier steel lockers in these recommendations will be also acted upon by the conference.

Germany Claims World's Fastest Freight Train

The distinction of having the world's fastest freight train is claimed by the German railways. The train is composed of twenty cars of a new type, each of fifty tons' capacity, and although its weight is practically double that of a standard express train it can, from full speed of about 100 kilometers (approximately 62½ miles) per hour, be stopped at a braking distance of only about 3,300 ft. This performance is rendered possible by the design of the cars and locomotive, by the use of specially designed high-speed pneumatic brakes, and, finally, by the use of automatic couplers.

Letter Ballot on Standard Box Cars

The American Railway Association has issued Circular No. DV-376 giving the results of the second letter ballot on standard box cars. The board of directors has approved propositions five, seven and eight containing the recommendations of the Mechanical Division as to the standard single-sheathed box car and the types W and Y trucks, including bolsters, side frames and other details. In the case of proposition six relating to the standard double-sheathed steel box car, in order to obtain interchangeability of roofs and the maximum of standardization with details already incorporated in the single-sheathed car, it was the opinion of a majority of the General Committee that this car should be designed to an inside width of 8 ft. 9⅛ in. The General Committee, however, was unable to agree upon a unanimous recommendation. Proposition six will be given further consideration by the Car Construction Committee and the General Committee and a ballot considered later.

The Santa Fe's Reserve Corps, U. S. A.

Under the plan of the United States War Department to form a number of railroad battalions as part of the organized reserved corps of the army, the 612th Engineer Battalion has been allocated to the Atchison, Topeka & Santa Fe, and the personnel will be drawn from employees on lines between Chicago and Denver, Colo., Purcell, Okla., and Waynoka, Okla. The battalion consists of four parts, the first being the battalion headquarters and headquarters platoon; the second, a maintenance of way company, or company A; the third, a maintenance of equipment company, or company B; and the fourth, an operating company, or company C. Men have been selected for commissioned officers and an effort is being made to secure men for non-commissioned officers and privates to fill these companies. Enlistment in the organization does not obligate a man in such a manner as to interfere with his business or vocation in normal times. This battalion will function only in times of war with a major power and cannot be called into service for local disturbances such as riots or strikes.

Trial by Jury in Contempt Cases Arising Out of Labor Injunctions

The United States Supreme Court, in a decision rendered on October 20, upheld the provision of the Clayton law which provides for a trial by jury in contempt cases arising from violations of court injunctions in connection with labor disputes. In this it reversed the seventh circuit court of appeals which had affirmed a decision of the United States court for the western district of Wisconsin in the case of striking shop employees of the Chicago, St. Paul, Minneapolis & Omaha, who had been sentenced for contempt for violation of an injunction issued by the court by conspiring to interfere with interstate commerce. The lower court had held that while on strike the men were not "employees" within the meaning of the law. The Supreme Court, in the opinion by Justice Sutherland, held that they were "employees" within the meaning of the law and that it was not necessary for this purpose that the old status of employer and employee should exist at the time the alleged contempt was committed to make the jury trial provision of the law effective.

Canadian Unions Protest Against Claim That Wages Are Too High

Railway men's unions throughout Canada have joined in a protest to the Dominion Railway Board against statements made in the recent application of the Tudhope Anderson Company of Winnipeg and Orillia, Ont., which firm in urging decreased freight rates took the ground that wages paid to railway employees were unreasonably high, unfair and extravagant. The railway men's memorial declares these statements to be untrue, and assumes that the Railway Board will not attempt to interfere in matters outside its jurisdiction.

Negotiations between the Canadian National Railways and conductors and trainmen employed on that road in respect to wages and conditions have been postponed subject to reopening upon intimation by the men of a desire to resume. The negotiations opened in February last following a demand from the men that a similar settlement to that recently put into force on the New York Central and other United States lines should become operative on the Canadian National.

Fuel Consumption on the M. P.

Fuel consumption on the Missouri Pacific during July was .9 of a gallon per car mile in passenger service and 9.6 gal. per thousand gross ton-miles in freight service. A record has been kept of each district in each class of service showing the gallons consumed per passenger car-mile and per thousand gross ton-mile including all the fuel used in through and local passenger service, through and local freight mixed trains, traveling switch and light engines running for the benefit of freight and consumption at all terminals. The St. Louis district coal burning engine in passenger car service averaged 12.6 lb. per passenger car-mile equivalent to one gallon of oil per car-mile. Coal burning engines in freight service averaged 96 lb. per thousand gross ton-mile equivalent to 7.6 gal. of oil. In passenger service the McAlester district ranked first among the districts with .8 gal. per car-mile and 8.7 cars per train. In the freight service the McAlester district also ranked first with 7.7 gallons per thousand gross ton-mile and 2,276 average tons per train. In yard service the North Texas district ranked first, having used 9.4 gal. per engine-mile. Among the unusual economical consumptions during August an engine on an excursion from Waco, Tex., to Galveston with 12 cars consumed 2,025 gal. of oil in making 3,456 passenger car-miles or .58 gal. per car-mile. Another engine in June burned 7,509 gallons of oil, making 9,124 car-miles or .8 gal. per car-

mile. In July the same fireman used 5,813 gal. making 6,751 car-miles or .8 gallon per car-mile and in yard service in August he used 8.3 gal. per engine-mile. On August 23 a crew handled 1,802 tons from Smithville, Tex., to New Ulm, 3,408 tons from New Ulm to Houston, a total of 70 miles or 319,560 gross ton-miles on 1,256 gal. of oil or four gallons per one thousand gross ton-miles. The run was made in 7 hrs. 35 mins., taking water twice, 16 in. of water being in the tank on arrival at Houston.

Valuable Show Horses Are Burned in Express Car

Eight valuable show horses were burned to death or injured so seriously that they had to be shot and four men came near losing their lives when an American Railway Express car, attached to train No. 82, of the New York Central, caught fire, Friday, October 10, when approaching Dunkirk, New York. The horses, which were valued at $18,000, were en route from their stables in Cleveland, Ohio, to the Madison Square Gardens, New York. They were in charge of four caretakers who were riding in the car at the time it caught fire.

The car was of wooden construction and was placed first in the train next to the locomotive. It is presumed that the fire started from a spark alighting in the straw which covered the floor. This, however, could not definitely be determined. It was declared by the caretakers that there was no means of signaling the engineman and all that they could do was to fight the fire and wait for the train to stop, which was at Dunkirk. A by-stander at the Union Station at Dunkirk, seeing that the car was in flames turned in an alarm and both the Dunkirk fire and police departments responded. One of the horses jumped from the car at the Central avenue crossing in Dunkirk and broke its leg, necessitating the shooting of the animal. Another horse succeeded in jumping safely from the car at Deer street crossing and it is reported that he will recover. The remaining six horses had to be shot.

FREIGHT CAR REPAIR SITUATION

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1
March 1	2,262,254	119,505	49,277	168,782	7.5
April 1	2,274,750	125,932	46,815	172,747	7.6
May 1	2,271,638	131,609	47,666	179,275	7.9
June 1	2,280,295	138,536	50,683	189,219	8.3
July 1	2,279,826	144,912	49,957	194,869	8.5
August 1	2,278,773	153,725	49,139	202,864	8.9
September 1	2,296,589	158,200	51,909	210,109	9.2
October 1	2,304,020	157,455	48,589	206,044	8.9

Month	Cars repaired: Heavy	Light	Total
December	87,758	2,073,280	2,161,038
January	76,704	2,083,583	2,160,287
February	70,056	2,134,781	2,204,837
March	77,365	2,213,158	2,290,523
April	75,352	2,074,629	2,149,981
May	73,646	2,130,284	2,203,930
June	70,480	1,888,899	1,959,379
July	72,347	1,567,430	1,639,777
August	71,863	1,420,482	1,492,345
September	74,295	1,372,277	1,446,572

PASSENGER CARS ORDERED, INSTALLED AND RETIRED

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Jan.-March	792	679	54,370
April-June	513	555	54,328
July-Sept.	553	531	54,349
Oct.-Dec.	861	948	54,262
Full year, 1923	2,719	2,713	......
1924			
Jan.-March	609	431	54,519
April-June	698	552	54,668

Figures cover Class I roads reporting to Car Service Division.

Number of Three-Cylinder Locomotives Increasing

An order has recently been placed by the Lehigh Valley with the American Locomotive Company for five three-cylinder locomotives, duplicates of the original No. 5000 type, which was on exhibition at the Atlantic City convention of the American Railway Association. This company has also recently announced an order from the Wabash for 50 Mikado type locomotives, five of which are to be of the new three-cylinder type. The Delaware, Lackawanna & Western has placed an order with this company for two three-cylinder Mountain type locomotives. At present there are three-cylinder locomotives in operation on or under construction for the Lehigh Valley, the New York Central, the New York, New Haven & Hartford, the Missouri Pacific and the Wabash. Five locomotives of the three-cylinder type were recently shipped to South Manchuria. Additional statistics show that there are in operation or under construction in England over 250 locomotives of this type, approximately 2,100 in Germany, as well as many others in Sweden, Switzerland, Brazil and the Argentine Republic.

Southern Pacific Orders 4-10-2 Type Locomotive

The American Locomotive Company has announced the receipt of an order for a three-cylinder locomotive from the Southern Pacific. One of the features is the unusual wheel arrangement which might be considered as an evolution of the Mastodon 4-10-0 type locomotive. The design of the new locomotives includes a set of trailer wheels, which gives it a 4-10-2 wheel arrangement, which is the first of this type ever built in the United States. It will be known as the Southern Pacific type. It is claimed that this locomotive will be the largest and the most powerful articulated locomotive in the world. Some of the principal dimensions and weights are as follows:

Railroad	Southern Pacific
Builder	American Locomotive Company
Type of locomotive	4-10-2
Cylinders, diameter and stroke:	
Two outside	25 in. by 32 in.
One inside	25 in. by 28 in.
Weights in working order:	
On drivers	310,000 lb.
Total engine	438,000 lb.
Driving wheels, diameter outside tires	63½ in.
Boiler steam pressure	225 lb.
Tender:	
Water capacity	12,000 gal.
Fuel capacity	4,000 gal. oil

Labor News

ENGINEMEN'S BROTHERHOOD MINES HAVE TROUBLE WITH UNION EMPLOYEES.—The Coal River Collieries Company, which operates coal mines in West Virginia and Kentucky and is owned by members of the Brotherhood of Locomotive Engineers, has refused to sign a wage agreement with the United Mine Workers of America because it cannot earn its expenses while operating under the union scale of wages, according to Warren S. Stone, chairman of the brotherhood and of the board of directors of the coal company. The brotherhood members closed down their mine rather than pay the wages demanded by the union. This action brought a strong letter of protest to Mr. Stone from John L. Lewis, president of the Mine Workers' Union, declaring that the brotherhood's company has assumed the same attitude as other operators in the field.

"This is an intolerable position for a coal company whose stock is largely owned and whose affairs are directed by union men, to occupy," Mr. Lewis said.

In reply, Mr. Stone declared that "the members of the Brotherhood of Locomotive Engineers who have invested over $3,000,000 in these properties are entitled to some return on their investment and I think you will concede this; yet at the present price at which

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	*64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
May 1	64,330	52,899	6,079	6,105	9.5	5,335	8.3	11,440	17.8
June 1	64,373	53,498	6,661	6,099	9.5	4,776	7.4	10,875	16.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
August 1	64,486	53,381	7,152	6,073	9.4	5,032	7.8	11,105	17.2
September 1	64,582	53,618	6,762	6,023	9.3	4,941	7.7	10,964	17.0
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6

coal is selling and the cost of mining under the Jacksonville agreement it is impossible for the union mines to break even."

Brotherhood Wage Negotiations.—The anticipated test of the powers of the United States Railroad Labor Board under the Transportation Act was begun in Chicago on September 29 when a petition was filed with the United States District Court by the Labor Board, asking that John McGuire, general chairman of the Brotherhood of Locomotive Engineers on the Chicago & North Western, and O. B. Robertson, president of the Brotherhood of Locomotive Firemen & Enginemen, be compelled to testify before the board. The two defendants in the present case, as well as a number of other brotherhood officials, had twice ignored subpoenas of the Labor Board to appear and testify in the controversy with the western railways over proposed changes in wages and working rules.

The petition was filed before Federal Judge James H. Wilkerson by Edwin A. Olson, United States attorney, and Weymouth Kirkland and Robert N. Golding, special assistants to the United States attorney general. Mr. Kirkland opened arguments before Judge Wilkerson on October 21.

Donald R. Richberg, counsel for the brotherhoods, declared that the statement of facts in the Labor Board's petition was incorrect and that the defendants would therefore not move for dismissal, since such a motion would entail acquiescence in the statement of facts, but would file an answer, setting forth their version of the facts of the dispute.

MEETINGS AND CONVENTIONS

International Railway Congress at London

The next congress of the International Railway Congress Association will be held in London from June 22 to July 6, 1925. Besides the regular business, the congress will make a number of excursions to places of railway interest in Great Britain—among them the Swindon works of the Great Western Railway, Darlington (where the centennial of British railways will be celebrated), Windsor, Canterbury, Edinborough, Glasgow and the great Clyde industrial district. The chairman of the arrangements committee is Sir Evelyn Cecil, G. B. E., director of the Southern Railway, 2, Cadogan Square, London, S. W. 1.

Chicago Car Foremen Elect Officers

At the annual meeting of the Car Foremen's Association of Chicago, held at the Hotel Morrison on Monday evening, October 13, the following officers were elected for the year 1924-25: President, Alfred Herbster, district general foreman, New York Central, Chicago, Ill.; first vice-president, J. E. Mehan, assistant master car builder, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; second vice-president, E. H. Wood, car foreman, Michigan Central, Chicago. F. C. Schultz, chief interchange inspector, Chicago Car Interchange Bureau, was re-elected treasurer. Aaron Kline, who has served the association faithfully as a secretary for 25 years, was also re-elected to the position of secretary.

National Safety Congress Meets at Louisville

The National Safety Congress, comprising those representatives of steam and electric railroads and of other industries and associations who are engaged directly or indirectly in the promotion of the health and safety of the public and of employees, held its thirteenth annual congress at Louisville, Ky., on September 29 to October 3, inclusive, at which time an extensive program of addresses, reports and exhibits on safety work was made available to those present.

Over 100 were present at the first session of the Steam Railroad Section which was held in the Seelbach Hotel on Tuesday morning, where Henry Bruere, a member of the board of directors of the Chicago, Rock Island & Pacific, and winner of the recent Railway Age contest on co-operation between railways and their employees, delivered an address on better management through co-operation, which was followed by a paper on the development of safety on the railroads by Charles Frederick Carter, author of "When Railroads Were New." Other sessions of the Section were held on Wednesday and Thursday morning, when papers were presented and discussions held on special railroad safety problems and work. These discussions were devoted in large part to getting the viewpoint of officers engaged directly in the work of the departments considered.

The officers of this Section are as follows: Chairman, Fred M. Metcalfe, superintendent of safety, Northern Pacific; vice-chairman, Charles E. Hill, general safety agent, New York Central; and secretary, E. R. Cott of the Hocking Valley. The election of officers for the ensuing year resulted in the choice of Charles E. Hill for chairman, and for vice-chairman and secretary, A. V. Rohweder of the Duluth, Missabe & Northern, and E. G. Newman of the Union Pacific, respectively.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room, 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foreman's Association.—G. G. Macina, 11402 Calumet ave., Chicago.

American Society of Mechanical Engineers—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Annual meeting December 1-4, 29 W. Thirty-ninth street. Railroad Division, A. F. Stuebing, Bradford Corp., 23 West Forty-third street, New York. Meeting December 2, 2:00 p. m.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting November 11. Paper on The Yardmaster—His Duties and Problems, will be read by T. Collins, superintendent terminals, Canadian Pacific, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt street, New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y. Next meeting November 14. Paper on What a Railroad Club means to its Members, will be presented by R. V. Wright, managing editor, *Railway Age*.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting November 12. Illustrated lecture.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting November 3. Paper on Problems of Supervision will be presented by D. C. Buell, director Railway Educational Bureau, Omaha, Neb. At the December meeting W. H. Davis, service engineer, Universal Packing Company, will speak on Practical Lubrication of Railroad Equipment.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central 2347 Clark ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan ave., Chicago, Ill.

International Railway General Foreman's Association.—William Hall, 1061 W. Wabash street, Winona, Minn.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt street, New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting November 10. Paper on Safety on Interstate Commerce Commission will be read by A. G. Pack, chief inspector, Interstate Commerce Commission.

New York Railroad Club.—H. D. Vought, 26 Cortlandt street, New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York. Next meeting November 21. Paper on the Articulated Car will be presented by William G. Gove, superintendent equipment, Brooklyn-Manhattan Transit Lines.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine street, San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting November 14. Paper on The Steam Locomotive with Special Reference to Three Cylinder Type, will be presented by J. G. Blunt, American Locomotive Company. Illustrated by stereopticon.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 138 West Madison street, Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Stafford Roller Bearing Car Truck Corporation, Lawton, Mich., has been purchased by J. S. Stearns, Ludington, Mich.

The Whiting Corporation, Harvey, Ill., has moved its Detroit office from 3000 Grand River avenue to 650 Baltimore avenue west.

The Superheater Company, New York, is preparing plans for the construction of a one-story power house at East Chicago, Ind.

The Globe Railway Equipment Company has been organized in St. Louis, Mo., to manufacture railway specialties among which is a car door hanger.

Carl J. Mellin, for many years consulting engineer of the American Locomotive Company, died at his home at Schenectady, N. Y., October 15. Mr. Mellin was born in Westergotland, Sweden, on February 17, 1851. He received his education at Alingsos and Gothenberg, Sweden. At the age of 19 he entered the Swedish State Railway shops, and three years later became a draftsman with the Gothenberg Marine Engine Works. In 1877 Mr. Mellin removed to Scotland, where he became connected with the Robert Napier & Sons Marine Works, remaining there until 1880, when he returned to Sweden, serving as superintendent and mechanical engineer of Thorskag & Eriksbergs Marine & Shipbuilding Co. In 1887 he came to America and served in New York City as designer for the Dynamite Gun Co., taking an active part in the development of designs for the cruiser *Vesuvius,* and later he went as mechanical engineer with the Richmond Locomotive Works. While in Richmond Mr. Mellin had charge of the design and construction of the machinery for the U. S. Battleship *Texas*, and he developed the system of locomotive compound cylinders which became known as the Richmond compound and which has been used extensively on domestic and foreign railways. In 1894 he became chief engineer of the Richmond works, retaining this position until the formation of the American Locomotive Company in 1901. In 1902 Mr. Mellin went to Schenectady as consulting engineer, which position he held until the time of his death. Among important designs promoted by Mr. Mellin were the articulated compound locomotive, the adaptation of the Walschaert valve motion to American conditions, the first successful power reverse gear and several types of superheater. Over fifty patents were assigned to him, chiefly for locomotive details. He was an active advocate of the use of three-cylinder locomotives, and at the time of his last illness he was engaged in designing a three-cylinder compound engine. Mr. Mellin traveled extensively in Europe and America in the interest of naval and railway engineering, and because of his service in the engineering field he was knighted and decorated by the late King Oscar of Sweden.

C. J. Mellin

Karl Kendig, advertising manager of the Whitman & Barnes Company, Akron, Ohio, has been advanced to the position of secretary of the company.

J. M. Robb, 929 Monadnock building, Chicago, has been appointed representative in that territory of the Economy Railway Appliance Company, Ltd., Montreal.

Walter C. Doering, representative at St. Louis, Mo., of the Bradford Corporation, New York, has been appointed vice-president in charge of the St. Louis office and of its business in the southwest territory.

The Pullman Car & Manufacturing Corporation has asked bids for the construction of a one-story, 280 by 484 ft., passenger car finishing plant at Pullman, Ill., to cost $500,000.

The Mid-Continent Tank Car Company, Coffeyville, Kans., will construct a branch plant for building and repairing tank cars on a 22-acre site recently purchased at Shreveport, La.

The General American Tank Car Corporation plans the construction of a plant on a tract of 230 acres at Good Hope station on the Yazoo & Mississippi Valley near New Orleans, La.

The Standard Railway Equipment Company and the Union Metal Products Company have moved their Chicago office to room 1422 Strauss building, 310 South Michigan avenue, Chicago.

L. G. Pritz, vice-president of the Sizer Steel Corporation, Buffalo, N. Y., has been appointed vice-president in charge of all operations of the United Alloy Steel Corporation, Canton, Ohio.

The Conveyors Corporation of America, Chicago, has appointed the W. P. MacKenzie Company, 1234 Callowhill street, Philadelphia, Pa., as its sales representative in southeastern Pennsylvania and southern New Jersey.

C. M. Hannaford, American National Bank building, Richmond, Va., has been appointed representative in that territory for the Locomotive Firebox Company, Chicago, manufacturers of the Nicholson Thermic syphon.

A. J. Pizzini, president of the Railway Improvement Company, New York, has also been elected president of the Waugh Equipment Company, instead of A. J. Tizzini, as was reported in the October issue of the *Railway Mechanical Engineer.*

Michael H. Connelly, formerly sales agent for the American Car & Foundry Co., has resigned to become manager of sales for the Albany Car Wheel Company; the Reading Car Wheel Company and the General Steel Casting & Machine Co., with office at 8 Lister avenue, Newark, N. J.

W. A. Garrett

Major W. A. Garrett, general transportation manager of the Baldwin Locomotive Works, Philadelphia, Pa., died on October 10 at his home in Moylan, Pa. William A. Garrett was born on August 18, 1861, at Canton, Miss. He entered railway service in 1876 as a messenger in a ticket office on the Ohio & Mississippi Central. He then went to the St. Louis Union Depot Company, where he worked his way up through various departments to the position of assistant superintendent. From March, 1893, to January, 1896, he was superintendent of the Terminal Railroad Association of St. Louis and terminal superintendent of the Wabash; also for the last two years of this period, superintendent of the St. Louis Merchants' Bridge Terminal Railway. He then severed his connection with the Terminal and was appointed superintendent of the Western division of the Wabash, later serving on the Middle division of the same road. In August, 1899, he was appointed superintendent of the Philadelphia division of the Philadelphia & Reading, later going to the New York division; and in March, 1902, was promoted to general superintendent. The following May he was appointed general manager of the Cincinnati, New Orleans & Texas Pacific and the Alabama Great Southern. From December, 1906, to March, 1907, he was vice-president of the Seaboard Air Line and then to October, 1909, was president of the same road. Major Garrett served from October, 1911, to September, 1912, as chairman of the General Managers' Association of Chicago and the Association of Western Railways. From September, 1912, to

W. A. Garrett

1913, he was vice-president of the Chicago Great Western and then served as chief executive officer to the receivers of the Pere Marquette. In 1914 he made a special study for presidents of lines terminating at Chicago, and in 1917 a special study of French railways for the United States War Department. He acquired his military title when he went to France as major of engineers in the army. He spent four months abroad with three other members of a commission and submitted a report to the War Department at Washington, on which were based the plans for transportation of American troops and supplies. From May, 1915, to December, 1918, he was assistant general manager of the Remington Arms Company at Eddystone, Pa., leaving that work to enter the service of the Baldwin Locomotive Works on January 1, 1919, where he served as general transportation manager until the time of his death.

Henry R. Towne

Henry R. Towne, chairman of the board of directors of the Yale & Towne Manufacturing Co., Stamford, Conn., died on October 15 at his home in New York. Mr. Towne was born in Philadelphia, Pa., on August 28, 1844. He attended the University of Pennsylvania but left before graduation, receiving, however, the honorary degree of M.A. in 1887. He first served in the drafting room of the Port Richmond Iron Works at Philadelphia. In 1866 he made an extensive tour of the leading engineering establishments in Great Britain, Belgium and France, and took a special course in physics at the Sorbonne, Paris. After returning to the United States he worked for some time in the shops of William Sellers & Co., Philadelphia. In October, 1868, he formed a partnership with Linus Yale, Jr., with Mr. Yale as president, and the Yale Lock Manufacturing Company was established at Stamford, Conn. Mr. Yale died shortly after, and in 1869 Mr. Towne became the president of the company, which at that time had a factory with 30 employees at Stamford and a sales room in New York. Mr. Towne continued as president until March, 1915, when he desired to retire from the duties of that office and was elected chairman of the board. During the earlier years of the company's existence Mr. Towne actively directed both the manufacturing and commercial sides of the business, but as the volume increased he devoted more and more of his time to the latter. The company at first made bank locks and the Yale pin tumbler locks. Later there were added safe deposit locks, mortise locks, Yale time lock, etc. The company also had an important business in complete post office equipments. A bronze department was added in 1873, and in 1882 it established an art department. The company secured the American rights for the Weston differential pulley block. It was also one of the first in America to build cranes, but the crane business was later sold to the Brown Hoisting Machinery Company, Cleveland, Ohio. The name of the company was changed in 1883 to the Yale & Towne Manufacturing Company. In 1878 the company absorbed the United States Lock Company and the American Lock Company; in 1894 the Branford Lock Works and in 1895 the Blount Manufacturing Company, in each case adding new lines. Mr. Towne was an active member of the American Society of Mechanical Engineers for many years and served as its president in 1888 and 1889. He had also been active in the affairs of the Merchants' Association of New York and had been its president from 1907 to 1913, and he had also served as treasurer of the National Tariff Commission Association.

H. R. Towne

William M. Ryan, president of the Youngstown Steel Car Company, Niles, Ohio, has resigned following his election as president of the Ryan Car Company, Chicago, as reported in the October issue of the *Railway Mechanical Engineer*. R. D. Bartlett, assistant to the president, has been promoted to vice-president, and Reginald Cooke, general manager, has been promoted to secretary and treasurer.

The Beaudry Company, Inc., is now occupying its new factory at Revere Beach Parkway, Everett, Mass. The main building, which is of concrete and steel sash construction, is 140 ft. by 70 ft. The center bay has about 30 ft. of head room and is served by an electric traveling crane. The side bays are somewhat lower and have a balcony for lighter machine work and storage, giving a total floor area of about 16,000 ft.

L. B. MacKenzie, one of the founders of the Railway Electrical Engineer, died suddenly in Chicago recently. Mr. MacKenzie was formerly also the owner of the Signal Engineer, now known as Railway Signaling and published by the Simmons-Boardman Publishing Company. He had been identified with the publication business for a number of years and at the time of his death was president and editor of the Welding Engineer, a paper devoted to the field of autogenous welding.

The Premier Staybolt Company, Pittsburgh, Pa., has appointed James C. Barr, district representative in New England, with headquarters at 84 State street, Boston, Mass. J. P. Armstrong has been appointed district representative on the Pacific coast, to succeed E. F. Boyle, deceased; Mr. Armstrong's headquarters are in the Hobart building, San Francisco, Cal., and C. E. Fuller, Jr., has been appointed representative in the Rocky Mountain district with office in the Barth building, Denver, Colo.

The Detroit Machine Tool Company, Detroit, Mich., manufacturers of centerless grinding machines, has been consolidated with the Norton Company, Worcester, Mass., manufacturers of grinding wheels and grinding machines. No change has been made in the business policy of the Detroit Machine Tool Company. Harold W. Holmes will continue as president and general manager and the following officers and directors of the Norton Company have been added to the board of directors of the Detroit Machine Tool Company: Clifford S. Anderson, vice-president, Henry Duckworth, treasurer, William LaCoste Neilson and Aldus C. Higgins.

Charles A. Carscadin, general sales manager of the Bradford Corporation, with headquarters at Chicago, died suddenly on October 8 at San Francisco, Calif. He was born in Buffalo, N. Y., and entered railway service in 1881 as a stenographer in the employ of the New York Central & Hudson River, now the New York Central, at New York, which position he held until 1882 when he left to become stenographer and secretary to the president of the Michigan Central at Detroit, Mich. From 1887 to 1902 he was a traffic representative of the same road. From the latter date until the present time he was engaged in the railway supply business, having been connected with the Detroit Seamless Tube Company, the Globe Seamless Tube Company and the National Car Equipment Company. He was elected a vice-president of the Joliet Railway Supply Company in October, 1917, which position he held until July, 1922, when he was made vice-president of sales. In November, 1923, upon the organization of the Bradford Corporation, he was elected general sales manager, which position he has held until his death.

George W. Lyndon, president of the Association of Manufacturers of Chilled Car Wheels, died in Chicago on October 7. Mr. Lyndon was born at Rochester, N. Y., on February 16, 1859. After graduating from high school in 1877 he studied law with Charles K. Ladd, Kewanee and Turner A. Gill at Kansas City, Mo., until 1880 when he entered railway service with the Kansas Pacific at Kansas City, Mo. Shortly thereafter he was transferred to Omaha, Nebr., on account of the consolidation of the Kansas Pacific with the Union Pacific. He remained with the Union Pacific as chief clerk of freight accounts until 1885 when he became traveling auditor of the Kansas City, Ft. Smith & Memphis, with headquarters at Kansas City. In 1887 he was appointed freight auditor, resigning in 1889 to accept a position as freight auditor of the Chicago, Kansas City & St. Paul, now a part of the Chicago Great Western. In 1890 he resigned to become general auditor of the Griffin Wheel Company and the Ajax Forge Company. Later he was made manager of the improvement and review department of these companies, which position he held until 1907. In 1908 he was made western secretary of the Railway Business Association and in the same year he was appointed secretary and treasurer of the Association of Manufacturers of Chilled Car Wheels, which position he held until October 27, 1914, when he was elected president, with headquarters at Chicago.

TRADE PUBLICATIONS

SAND DRYING EQUIPMENT.—The Roberts & Schaefer Company, Chicago, has issued an eight-page bulletin descriptive of its railroad sand drying equipment.

BOSTON GEARS.—Specifications and prices of some new styles and sizes of Boston gears are given in circular C3-24 recently issued by the Boston Gear Works, Norfolk Downs, Quincy, Mass.

ALLOY STEELS.—A 48-page, illustrated handbook covering Agathon alloy steels and containing a number of tables of data of interest to metallurgists and engineers, has been issued by the Central Steel Company, Massillon, Ohio.

SECTIONAL CONDENSER.—A condenser, built in two or more sections and designed to operate either as a standard, reflux, or partial condenser, or as a condenser and heat exchanger at the same time, is described in Form 198 issued by the Griscom-Russell Company, New York.

LOCOMOTIVE FEED WATER HEATERS.—Spare parts lists for feed water heater condensate return tank parts and washout apparatus parts have been issued by the Superheater Company, New York, in the form of Bulletins H-3-a and H-3-b, respectively. Each of the parts are illustrated.

OIL ENGINES.—General specifications for Foos oil engines, Type R, are given in an eight-page bulletin, No. 704, recently issued by the Foos Gas Engine Company, Springfield, Ohio. Other types of Foos oil and gas engines are illustrated and briefly described in bulletin No. 705.

ELECTRIC LIFT TRUCKS.—Bulletin No. 5-A, descriptive of an electric lift truck and skid system for industrial transportation, has been issued by the Cowan Truck Company, Holyoke, Mass. On pages 10 and 11 particular reference is made to the application of the Cowan truck to railway service.

POWER UNITS FOR RAIL CARS.—Detailed information concerning the construction and operation of Oneida power units for gasoline rail cars used on either standard or narrow gage railroads, is given in an illustrated catalogue recently issued by the Oneida Manufacturing Company, Green Bay, Wis.

POWER REVERSE GEAR.—On page 649 of the October issue of the *Railway Mechanical Engineer* mention was made of the issuance of bulletins Nos. 227-A and 228-A, descriptive of the Ragonnet power reverse gear, by the Franklin Railway Supply Company, New York. This was in error as bulletin No. 227-A has been discontinued.

CHAIN GRATE STOKERS.—A complete discussion of both the Type A (natural draft) and Type G (forced draft) Illinois chain grate stokers is given in a 62-page catalogue recently issued by the Illinois Stoker Company, Alton, Ill. An array of blueprint drawings illustrate the use of both the forced and the natural draft chain grate stokers in connection with all of the principal types and makes of boilers.

SAFETY VALVES.—Sectional drawings, showing the construction and operation of automatic cushioned altitude valves for maintaining a uniform water level in tanks, standpipes and reservoirs, regardless of climatic conditions, are shown in print No. 801, recently issued by the Golden-Anderson Valve Specialty Company, Pittsburgh, Pa. Other types of Golden-Anderson safety valves are illustrated in a 16-page booklet.

LOCOMOTIVE GRATES.—The construction, the shaking action and the economies derived from the adoption as standard equipment of the Hulson locomotive grate are fully described in a 19-page, illustrated booklet just issued by the Hulson Grate Company, Inc., Keokuk, Iowa. First the shaking action of the Hulson grate is described and illustrated by means of line drawings. On pages eight and nine will be found a description and illustrations of the pocket openings. The middle folio of the book contains a reprint of a blue print showing a typical general arrangement for a Mikado type locomotive. This is followed by a description and photographs of the various parts that make up the grate. On the last page will be found a summation of ten advantages of the Hulson grate.

PERSONAL MENTION

General

W. P. RUDD has been appointed general foreman, mechanical department, of the Pennsylvania, with headquarters at Pittsburgh, Pa., succeeding G. H. Burton.

A. R. SYKES, formerly general foreman of the shops and roundhouse of the Illinois Central at Jackson, Tenn., has been appointed assistant inspector of equipment of the Missouri Pacific System, with headquarters at St. Louis, Mo.

G. H. BURTON, general foreman in the mechanical engineering deparment of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been promoted to assistant engineer of motive power, with the same headquarters, succeeding W. P. Rudd.

W. W. ATTERBURY, vice-president in charge of operation of the Pennsylvania, has been elected vice-president, a new position made necessary by the approaching retirement of President Rea, which is scheduled for next year. General Atterbury will assist President Samuel Rea in the discharge of his duties and in the several important improvement projects which the company has in view, and will act as president in Mr. Rea's absence.

W. W. Atterbury

General W. W. Atterbury was born at New Albany, Ind., in 1866. He completed his education at Yale University in 1886. The same year he entered the Pennsylvania's service as an apprentice in the Altoona shops, and later served as assistant road foreman of engines on various divisions, assistant engineer of motive power and master mechanic. In 1896 he became superintendent of motive power of the Pennsylvania Lines East. In 1910 he became a general superintendent of motive power. On January 1, 1903, he was appointed general manager of the Lines East, and on March 24, 1909, was elected fifth vice-president in charge of transportation. He became fourth vice-president on March 3, 1911, and at the same time was elected a director of the Pennsylvania Railroad Company. On May 8, 1912, he was elected vice-president in charge of operation of the Lines East of Pittsburgh. From August, 1917, to May, 1919, he was director-general of transportation of the American Expeditionary Forces in France, with the rank of brigadier-general, and in that connection had charge of the details of organization for the construction and operation of the American transportation requirements, as well as harmonizing them with those of the allies. Since the return of the railroads to their owners upon the termination of federal control, General Atterbury has been vice-president in charge of operation of the entire Pennsylvania System.

Master Mechanics and Road Foremen

O. C. BRANCH has been appointed assistant road foreman of engines of the Seaboard Air Line, with headquarters at Hamlet, N. C.

EDWARD B. LEVAN, road foreman of the Northern Pacific, with headquarters at Missoula, Mont., has been transferred to Livingston, Mont.

H. Y. HARRIS, general foreman of the car department of the Seaboard Air Line at Tampa, Fla., has been appointed master mechanic of the Florida division, with the same headquarters, a newly created office.

C. F. Parker has been appointed master mechanic of the Kansas City Southern, with headquarters at Heavener, Okla., succeeding F. A. Prewitt.

B. G. Pauley has been appointed master mechanic of the Omaha division of the Chicago, Burlington & Quincy, with headquarters at Omaha, Nebr.

L. A. Osteen has been appointed assistant road foreman of engines of the Florida division of the Seaboard Air Line, with headquarters at Wildwood, Fla.

Luke J. Gallagher, engineer of the Rocky Mountain division of the Northern Pacific, has been promoted to road foreman, with headquarters at Missoula, Mont.

W. T. Pinner has been appointed assistant road foreman of engines of the South Carolina division of the Seaboard Air Line, with headquarters at Jacksonville, Fla.

Car Department

D. M. Raymond has been appointed general car foreman of the Union Pacific, with jurisdiction over the car and electric departments at Council Bluffs, Iowa, and Omaha, Nebr. Mr. Raymond entered the bridge and building department of the Union Pacific at Laramie, Wyo., in 1908. The following year he was transferred to the mechanical department. In 1911, he returned to the bridge and building department, in August, 1913, being again transferred to the mechanical department where he served successively as car repairer, inspector, head inspector, and assistant foreman. In September, 1921, he was appointed car foreman at Green River, Wyo., which position he held until his appointment as general car foreman.

D. M. Raymond

Shop and Enginehouse

W. P. Hartman has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Albuquerque, N. M.

T. L. Hartsock, night foreman of the East Altoona enginehouse of the Pennsylvania, has been appointed day foreman, succeeding B. K. Stewart.

T. W. Lowe, assistant general foreman of the Columbus shops of the Pennsylvania, has been promoted to general foreman, succeeding R. F. Lace, deceased.

J. Schneeberger, gang foreman of the Chicago and Alton, has been appointed general erecting shop foreman, with headquarters at Bloomington, Ill., succeeding A. B. Erickson.

T. H. Butler, night roundhouse foreman of the Illinois Central at Jackson, Tenn., has been promoted to day roundhouse foreman, with the same headquarters, succeeding R. W. Wilcox.

D. C. Cherry, gang foreman of the Juniata shops of the Pennsylvania, has been appointed night enginehouse foreman of the East Altoona enginehouse, succeeding T. L. Hartsock.

George F. Adams, shop superintendent of the Boston & Maine at Keene, N. H., has resigned, after more than 53 years of service. Mr. Adams was born in Nashua, N. H., April 16, 1855, and graduated from the Nashua high school, becoming an engine wiper in the old Nashua & Lowell enginehouse at Nashua in October, 1870. He subsequently served as locomotive fireman, blacksmith's helper and blacksmith, holding the latter position for nine years. During this time, because of illness, he also served for one year as clerk in the shop office, cashier at the freight house, foreman at freight house, yard clerk and passenger and freight brakeman. In 1883 he was appointed foreman blacksmith, five years later becoming assistant to the general foreman, and in June, 1890, general foreman, in charge of engine dispatching, freight car repairs, car inspection and general maintenance of way repair work. In 1914 he was transferred to Keene, and in 1923 was promoted to shop superintendent.

L. P. Ligon, inspector of shops and equipment of the Norfolk & Western, retired recently after having been in the service of the company for about 50 years. Mr. Ligon was born in Powhatan County, Va., on July 2, 1858. In 1869 he moved to Lynchburg, Va., and at the age of 16 became a machinist apprentice on the Atlantic, Mississippi & Ohio at Lynchburg, in which capacity he served until 1878. He then worked as a machinist until May, 1886, when he was promoted to foreman. In December, 1885, he was transferred to East Radford, Va.; in January, 1893, promoted to master mechanic of the Radford division, with headquarters at Radford; in March, 1894, transferred to the Pocahontas division; in September, 1904, appointed master mechanic of the General Eastern division; in February, 1918, appointed master mechanic of the Shenandoah division; in January, 1919, appointed master mechanic of the Shenandoah and Norfolk divisions; in August, 1919, appointed master mechanic of the Shenandoah division, and in January, 1923, appointed inspector of shops and equipment.

Purchasing and Stores

J. G. Hilgen has been appointed storekeeper of the Chesapeake & Ohio, with headquarters at Richmond, Va.

C. E. Branson has been appointed storekeeper of the Chesapeake & Ohio, with headquarters at Russell, Ky.

J. W. Cockrill has been appointed division storekeeper of the Illinois Central, with headquarters at Clinton, Ill., succeeding R. E. Downing, who has resigned to engage in other business.

J. L. Quarles, storekeeper of the Chesapeake & Ohio at Richmond, Va., has been promoted to assistant general storekeeper, with headquarters at Clifton Forge, Va., succeeding A. H. Young, Jr., who has been assigned to special work.

Obituary

R. F. Lace, general foreman of the Columbus shops of the Pennsylvania, died on September 9.

F. C. Hamilton, general roundhouse foreman of the Atchison, Topeka & Santa Fe, at Albuquerque, N. M., died recently at Kansas City, Mo.

Frederick S. Gallagher, engineer of rolling stock of the New York Central, with headquarters at New York, died on October 26 at St. Luke's Hospital, Yonkers, N. Y., from complications. Mr. Gallagher was born on August 1, 1871, at Tecumseh, Mich., and received a common school education at Plattsmouth, Nebr. He entered the service of the New York Central on September 17, 1900, as a draftsman in the office of the mechanical engineer at Collinwood, Ohio. Four years later he left the service of the New York Central, returning in 1906 to his former position. On October 1, 1905, he became chief draftsmen in the office of the assistant engineer of motive power at Collinwood and in 1911 he was appointed assistant engineer in the office of the general mechanical engineer at Grand Central terminal, New York. He was promoted to assistant engineer of rolling stock and motive power on July 1, 1917, and on June 1, 1920, he was promoted to engineer of rolling stock, which position he held at the time of his death.

F. S. Gallagher

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Prepare for Train Control Maintenance

Forty-nine railroads are supposed to have at least one passenger engine division equipped with automatic train control by January 1, 1925. A number of railroads have already installed some form of automatic train control on portions of their lines, but the problem of maintenance from the standpoint of the locomotive department has not had sufficient time to become of immediate importance. Approximately 80 per cent of the complications that comprise this apparatus are on the locomotive. The track installation is comparatively simple. This means that the larger part of the work of maintenance will fall to the mechanical department, which will, of course, be held responsible for its efficient handling. Success in this work will depend to a large extent on the knowledge and understanding that the enginehouse foremen, locomotive inspectors and road foremen have of the automatic train control equipment. Much can be done now to avoid future trouble by a careful study of the apparatus and its proper care and operation by the officers and men who will be directly concerned with its maintenance. Preparatory consideration should be given to the facilities for inspecting and testing the locomotive equipment at terminals. What preparation and study should be made will vary, of course, according to the type of equipment that has been selected. The fact that the character of the equipment is so different from what the mechanical department has been accustomed to handle should make the work of maintenance of unusual interest to many of the officers and men. Advance preparation and instruction in the maintenance of the automatic train control equipment should be started among the shop personnel so as to avoid the usual experimental blunders brought about through lack of knowledge. Such precautionary measures should tend to eliminate difficulties that might otherwise arise when the work of maintenance becomes a real factor.

Building for the Future

The statement has been made by vocational experts that about 75 per cent of the workers in industry are not doing the kind of work for which they are best suited. We know, also, that productive efficiency is seriously affected by the fact that many of the workers have not received adequate training and do not take the same interest in their work that they would if they understood not only how best to do the work, but its relationship to the functioning of the railroad as a whole, and the part which the railroad plays in the public interest. One development of the year which is now coming to a close has been the greater interest that has been shown in apprentice training on the railroads; there seems, also, to be a larger degree of interest being shown in the more careful selection of employees. A meeting in Detroit of employed boys from the railways was attended by 279 young men, representing 48 railway systems, from 33 states and provinces. Much time was spent in conference or discussion groups. It was clearly evident that these young men were seriously concerned as to how to make the best use of their peculiar talents. Undoubtedly they reflect the attitude of a great number of boys and young men engaged in railroad service. Most of the young men at the Detroit conference were from the mechanical department. From facts which were developed in the group discussions and from the searching questions which were asked in personal interviews, it is apparent that these boys will greatly appreciate advice and encouragement on the part of their superiors. Those of us who are older can recall many instances in which we were greatly inspired or greatly encouraged in our work by a little friendly interest on the part of an older, more experienced man. Sometimes, indeed, a little friendly advice or encouragement has been the turning point in our lives. What a wonderful thing it would be for the future of the railways if all those who are in positions of leadership today would make it a point to help the young men in their departments to find themselves and get a larger appreciation of their responsibilities and opportunities.

Why Not Assign Repairs?

In an endeavor to increase the efficiency of running repair work at engine terminals and to reduce the time locomotives must necessarily be held out of service for repairs, a great deal of attention is being directed towards the forms of organization of enginehouse forces, as well as the manner of assigning work. It is not the intention to discuss here the merits or weaknesses of the principle of assigned power as applied to the dispatching of locomotives. The value of the scheme as a whole and its adaptability depends, to a great extent, upon operating conditions. There is one element, however, in connection with assigned power, the merit of which can hardly be disputed, and that is the keen personal interest which each engine crew takes in the maintenance of its own particular locomotive. At some engine terminals, the work has been re-organized to the extent of assigning specialized gangs to the handling of repair work on locomotives as a class, for instance, passenger, Mallet and freight, and this scheme has made possible a material reduction in the man-hours required to repair locomotives, as well as to increase the number of locomotive miles per failure. One comparatively large eastern road has for some time past had in effect, an organization scheme at one of its large terminals which has developed the idea of specialized gangs to a still greater extent. Not only are the repair gangs in the engine house assigned to work on a certain class of locomotives, but to each gang has been assigned a specific list of individual engines. Experience has proved that in the same manner that the assigned road crew has shown an unusual interest in the maintenance of its own particular locomotive, these repair gangs have developed an unusual interest in their part of the maintenance of the individual

locomotives assigned to them. It is a coincidence that on this road the practice of assigning power to the road crews has been in effect for some time and there is gradually being developed a beneficial point of contact between the engineman and the shop man which has resulted in a spirit of co-operation that has been a contributing factor in the reduction of maintenance expenses at that terminal. An inspection of the detention reports for the division on which that terminal is located, brought out the fact that since this idea of assigned repair work has been thoroughly developed, a marked increase in the number of locomotive miles per failure has been realized along with the reduction of maintenance expenses.

Investigating Locomotive Derailments

One of the most irritating things that can happen in the routine of railway operation is a locomotive derailment. Such accidents interfere with the movement of traffic and usually both the mechanical and maintenance of way departments are called on for explanations. These explanations, of course, must be preceded by investigations. The investigation, in many instances, includes a visit to the scene of the derailment by the department heads or their representatives, a minute examination of the track by those representing the mechanical department and a similar examination of the locomotive by the representatives of the maintenance of way department. Such investigations seldom reveal the real cause of the derailment.

Derailments caused by obvious mechanical or track defects are not difficult to explain and rectify, but it is a puzzle to find the reason for a derailment when both the locomotive and track appear to be in good condition. Both the mechanical and maintenance of way officers are often at a loss to know just how to proceed in order to find the actual cause. In such cases a seemingly never-ending controversy is started owing to the lack of sufficient evidence to place the blame on some particular part or condition of locomotive or track.

A discussion of this kind of derailments is published on another page in this issue. In this article, which is the result of an investigation initiated five years ago, is developed a factor which has been called the factor of wheel bearing. It is a comparatively simple matter to calculate this factor for practically any type of rolling equipment. The value of this factor for the various classes of locomotives a road may be operating, is that it gives the mechanical engineer a figure upon which he can determine the relative possibilities of derailment from locomotives of each class. In case a derailment occurs, he has on file information that will help him to determine accurately what was the actual cause and what steps to take in order to prevent its recurrence.

Excellent results toward the prevention of derailments have been obtained on the roads where this system of investigation has been carried out. It has not only tended to eliminate the usual controversies between the mechanical and maintenance of way departments, but it has brought the two together in a co-operative effort to solve derailment problems. Both departments have a definite object to work for; that is, to keep the factor of wheel bearing within a certain limit. The mechanical department is limited to the extent it can adjust the weights on the drivers in order to get a suitable factor. From the results obtained by the mechanical department, the track department is able to determine the correct curve elevation for safe train operation. When both departments have done everything possible to provide safe locomotive and track conditions, they can then present definite figures to the operating department on which it can base its rules and regulations for the operation of trains. The method described in the article, which is largely analytical, is not intended as a means of discovering the cause of a derailment after it has occurred; its primary objective is to offer something definite toward preventing future derailments.

Precision in the Railroad Shop

In spite of the opposition which has been offered to practically every innovation which tended to remove or circumscribe the exercise of personal skill in industry, the trend has been constantly toward more complete control of industrial processes by the elimination of the variable quality of individual skill. This is seen in the use of special tools in repetitive processes by which parts are completed to extremely close tolerances without skilled attendance, in the control of heating operations by the use of pyrometers and automatic heat regulation, etc. In the railroad shop the freedom from the necessity of close limits in fits has left the control of tolerances generally in the hands of the workmen, on whose skill in estimating allowances the quality of the work depends. During recent months a series of articles in the *Railway Mechanical Engineer* has been devoted to the possibilities of closer tolerances in railroad work, controlled by the use of precision instruments in taking measurements. Among the advantages claimed in these articles may be particularly mentioned the more general interchangeability of many small motion parts and the better systemization of the transfer of measurements to the machine in finishing parts which work together. Probably one of the first objections to the adoption of such practices will be based on the lack of necessity for close tolerances because of the comparatively loose fits required on the locomotive.

No doubt the looseness of locomotive fits permits of considerable variation in the precision of dimensions and, if close precision were costly, it would obviously be undesirable. As pointed out in these articles, however, this has not been found to be the case where precision methods have been applied in a railroad shop. The experience in other industries also supports this conclusion. During the European war considerable difficulty was encountered at the outset in meeting what was considered extreme refinements in tolerances in the production of war material. On a certain shell contract, however, the expedient was adopted of fixing tolerances in the shop with even greater precision than those required to meet government specifications. The result was immediate and salutary. Rejections became negligible and the technique of working to the closer limits was found to be no more difficult and, in fact, to become more a routine matter than had been the case prior to the definite adoption of the closer limits in the shop. This is suggestive of what to a lesser degree may be accomplished in the railroad shop if advantage is taken of the full possibilities of the use of precision instruments. From their use, reduced to a simple routine, good results are less difficult to obtain than from dependence on the judgment of the individual in working out each fit in his own less systematic way.

Co-operative Mechanical Engineering Training

The mechanical departments of the railroads have frequently been criticized for not making more extensive use of men who have received a college training in mechanical engineering. It is true that some few railroads have conducted what is known as special apprentice courses for college graduates. Some of these courses, however, offer little more than the usual shop apprentice training. Others are designed to give the young men a more or less general training in mechanical department methods and practices; in addition to a certain amount of shop training in various departments, they are scheduled to do some work in the drafting room, in the office, in the

enginehouses, on testing of materials and other special work.

The Central of Georgia, in co-operation with the Georgia School of Technology, is developing a scheme of co-operative mechanical engineering education, which seems to possess many advantages over the special apprentice courses in recruiting young college men for railroad work. Boys who can qualify for the entrance requirements of the college and are satisfactory to the railroad on the basis of the tests passed by new employees, are entered in the co-operative courses, which cover a period of five years. In general, the boys spend one month at the college and one month with the railroad. Each boy has an alternate, who is in the shop while he is in the school, or vice versa. They are allowed short vacations during the Christmas holidays and the summer months, these vacations, however, being taken from the time in college and in no way interfering with the maintenance of a uniform force in the railroad service.

There appear to be very distinct advantages in these co-operative courses. In the first place, the boy enters railroad service at about the same age as the regular apprentice and does not have to start at the very beginning after he has finished his college training, as is true in the case of the special apprentice. He thus not only finds it easier to accommodate himself to the work in the railroad shops, but if it appears that he is not suited for this particular class of work, he can arrange for a transfer to something for which he is better suited. Too many boys who graduate from college find out too late that they have made a mistake and that their peculiar talents could be better utilized in other fields than that for which they have prepared. The fact that the co-operative students are earning money one-half of the time they are in college makes it possible for many young men to secure a college training, who for financial reasons would otherwise probably be deprived of that opportunity.

In general, it has been found that the co-operative students take their work more seriously than do the young men in the standard engineering courses. This is to be expected, since they can better understand how the theory which they are receiving in their college training can be applied in a practical way in industry. The Central of Georgia now has 56 co-operative students in the mechanical department, 16 in the electrical department and two in the signal department. Twenty-eight of these boys are first year men, 34 second year or sophomores, 8 third year or pre-juniors, and 4 fourth year or juniors. It is, of course, too soon to predict the final outcome of this experiment, but it would seem to contain great possibilities for providing a splendid training for recruits to the mechanical department.

New Books

Painting of Railway Equipment. *By B. E. Miller, master painter, Delaware, Lackawanna & Western.* 154 *pages, illustrated.* 4½ *In. by* 7½ *In. Price* $1.50. *Published by the Simmons-Boardman Publishing Company,* 30 *Church street, New York.*

A practical book on railway painting has been in demand for some time among railway men. There have been numerous books published on painting but none of them has attempted to specialize on the methods used in painting cars and locomotives. The purpose of this book is to supply such information to the railway painter.

The book is divided into three parts. Part I supplies the fundamental knowledge of paints and tools. The section is introduced with some general remarks on painting which are elemental in nature, but are essential for every painter to know. This is followed by a description of the various pigments and oils used in mixing and obtaining the various colors for different kinds of work. The nature and kinds of varnishes are clearly set forth. This section is concluded with a description of the various tools and how they are used by the painter. Part II covers the painting of passenger car exteriors. A complete description is given of the various processes used for painting the exterior of new wooden and steel passenger cars. This section is concluded with the reasons why passenger cars have to be shopped for repainting and the method of doing this work. Part III gives detailed information covering the painting of passenger car interiors, freight cars and locomotives. Throughout this section will be found special information of value to the railway painter such as methods of refinishing the interiors of new and shopped steel and wooden passenger cars; varnish room work, including a description of equipment such as sash and door racks; the use of an air brush or sprayer for painting freight cars; and the painting of locomotive parts requiring special attention.

Transactions Index, Volumes 1 to 45, 1880-1923. 222 *pages,* 5½ *In. by* 8¾ *In., bound in half-morocco. Price* $3.00. *Published by the American Society of Mechanical Engineers, New York.*

This edition of the Index to Transactions is the fifth which has been published since the appearance, in 1880, of the first volume of the published literature of the Society.

In preparing the present index, the intention has been to cover as thoroughly as practicable the material hidden sometimes in irrelevant discussions and sometimes in the papers themselves, which, on account of its different subject-matter, would escape the attention of the searchers in an index devoted primarily to the major subjects of formal papers. The items have also been fully cross-referenced.

Inasmuch as the material in the first 25 volumes is quite completely indexed in Volume 27, the present index should apply more particularly to Volumes 26 to 45, inclusive. It will be found, therefore, that the present index contains only a sufficient number of references to the first 25 volumes to locate the papers and their authors. No references to the discussers of these early papers are given, although such references are included in the general index of Volume 27.

Another difference in the present index lies in its arrangement. The general style of The Engineering Index has been followed, grouping alphabetically all items under authors' names and subjects, except memorial notices of deceased members, in the main section. No separate listing of authors or of papers in chronological order is attempted. References to purely Society affairs, such as accounts of meetings and addresses which do not deal with technical subjects, have been omitted. A separate index to memorial notices has been included.

What Our Readers Think

Setting Locomotives to Music

New York.

To the Editor:

At first thought, it seems to require a rather elastic imagination to compare the music of a symphony orchestra to the sounds produced by a locomotive under way—most locomotives, at least. Yet there is in reality a bond of sympathy existing between the endeavors of those who guide the movements of each—that striving for a degree of mechanical perfection that will produce results embodying both harmony and rhythm.

Two well known symphony orchestras have recently presented for the approval of their audiences in this country, a composition by Arthur Honegger, a French composer, entitled "Pacific 231." It seems that this young composer, from childhood, has had a passion for locomotives and if

the favorable comment which his musical production has created may be taken as an indication, it is safe to say that he has been unusually successful in translating the audible impressions of a powerful modern locomotive at high speed into a pleasing musical theme. The composer of "Pacific 231" has drawn a musical picture of a train driving through darkness at high speed. Quoting the words of the musical critic, he has projected an idealized vision of a marvelous modern world in which man has extended himself and his powers through muscles of steel and tissues of copper and brass. He has pictured man as a conqueror of time and space by his mechanical mastery of stupendous forces and the genius with which he has bent them to his will.

All this the composer has accomplished with music. The locomotive engineman may also be credited with a subconscious effort to produce "mechanical music" with the powerful machine under his control when, at the end of each run, he writes on his work report, "Square up valves."

LOCOMOTIVE "TUNER."

Reclaiming Files

LITTLE ROCK, Ark.

TO THE EDITOR:

A question was asked by James Sheridan in the November issue of the *Railway Mechanical Engineer* relative to the use of an acid solution for the reclamation of worn files. Dull or worn files can be sharpened by placing them over night in a solution of one part sulphuric acid to two parts of water. After being removed from the acid solution, they should be rinsed well in clear water.

The acid should be kept in an earthenware vessel.

J. W. BRODERICH,
Gang Foreman, Missouri Pacific.

Speculations on Locomotive Efficiency

COUNCIL BLUFFS, Iowa.

TO THE EDITOR:

The locomotive boiler is a most admirably effective steam producer, notwithstanding the limitations put on its design by considerations of clearance. It has a marked advantage over the stationary boiler, in that the water content is in a state of continual agitation when the locomotive is moving, which augments and assists the natural or gravity circulation of the water in the formation of steam.

To produce steam in large quantities necessitates the consumption of fuel at a rapid rate. On the limited grate area of the coal fired locomotive boiler, as compared with stationary boilers of equal capacity, a thick fuel bed must be maintained. Fresh fuel must be added at the top of the fire. The air for combustion is necessarily admitted at the bottom. Naturally the oxygen of the incoming air first comes into contact with the bottom layers of fuel, with the consequence that most perfect combustion is secured at some point well down in the depth of the fire. Above that point combustion proceeds in an atmosphere more or less impoverished of oxygen and at the upper surface of the fire, where the fresh fuel is undergoing the process of distillation, the oxygen content of the air is at a minimum. The volatile constituents of the fuel, containing hydrogen, require proportionately more oxygen for their perfect combustion than does the fixed carbon, while they actually are supplied with much less.

This condition seems to require two things for its correction. The first is the admission of more air through the grate space, which may be accomplished by careful design. The second is the admission of air above the fire. This latter remedy, to be effective, requires that the air be preheated. It may be accomplished by utilizing the brick arch, with which every locomotive should be provided. The arch tile may be made hollow so that when put in place the hollow spaces connect up to form a passageway for the flow of the air, outlets being provided on the under surface of the tile and the passageway for air connecting up at the lower end of the arch with a hollow stay in the throat water leg. Dampers may be placed over these stays so that control of the air is provided for.

The most nearly perfect combustion attainable requires about 16 lb. of air per lb. of combustible. On our larger locomotives this demands an air supply of one ton or more per minute, or over 25,000 cu. ft.

Locomotive flue gas analyses seldom show an excess of air. Generally the contrary is apparent as indicated by the presence of excessive CO in the flue gases. The problem of draft is therefore intimately related to that of combustion. It is well known that the present method of producing draft is inefficient, but is retained on account of its simplicity and because it does the work required of it, even though wasteful. The inefficiency can be laid to just one thing—excessively high exit velocity of the gases passing out of the stack. The velocity is sufficient to carry the gases up a considerable distance when less would just as well suffice.

In a centrifugal blower fan operating with free inlet and discharging directly into the open air, the power required to drive it is proportional to the cube of the speed. If you double the speed of the fan, it will deliver two times the volume of air at four times the dynamic pressure, thus requiring eight times as much power to drive the fan. The same rule holds good when the propelling power is a jet of steam. The loss is in the excess dynamic pressure of the ejected gases or air. Any experimental work looking to the substitution of a fan or blower to produce draft for the locomotive is sure to run afoul of this fact.

Reduction of exit velocity will necessitate a larger stack. A larger stack will require modification of the exhaust jets by breaking the single jet up into several smaller and more effective jets having larger entraining surface area. Greater continuity of the flow of the exhaust through the jets must be secured.

This latter suggestion leads to certain inferences. Just why is it necessary to provide four separate and independent exhaust passages up to the base of the nozzle? Why not simplify cylinder and saddle construction by leaving them out altogether, thus reducing pattern and molding costs and permitting the use of cast steel in saddle construction with increased strength and reduced weight?

What will happen if the separate exhaust passages are omitted and the space within the saddle be made into a receiver with the exhaust nozzle applied in the usual manner? Conceivably, on starting the locomotive, the first few exhausts will be irregular, but on the attainment of any speed this will disappear and the pressure within the receiver will become reasonably constant. The flow of the exhaust through the nozzle will then become practically continuous, a condition much more to be preferred for the production of draft than the intermittent action now secured.

The suggested omission of the exhaust passages leads also to further speculation. The receiver space may be utilized for the installation of a feed water heater, preferably of the closed type, an ideal location for it, as its heating surface will be in contact with the entire volume of exhaust steam, without in any way offering obstruction to its flow to the nozzle and with the assurance that maximum feed water temperatures will be secured.

The saddle may be made of cast steel in a single unit casting with independent unit cylinders bolted on, making the replacement of a damaged cylinder a simple matter and permitting the use of such material for cylinder construction as may be best suited with the assurance of better castings. Both unit cylinders may be cast from a single pattern with considerable saving in pattern cost. Several hundred pounds of excess weight may be eliminated.

THOMAS E. STUART.

Derailments of Locomotives on Curves

An Investigation of the Mechanics of Curving To Determine Why the Wheels Leave the Rail

Part I

By Roy C. Beaver* and Marion B. Richardson†

THOSE who are called upon to investigate the causes of locomotive derailments are frequently puzzled to know what to say in their reports. An investigation of the locomotive does not disclose any mechanical defect and the track seems to be in perfect condition. The operating conditions at the time of the derailment were satisfactory, and still the locomotive left the track. In many cases there does not seem to be any one factor or combination of factors at which to point the finger of blame.

One of the most common derailments on a curve is that in which the outside leading driver climbs the rail while the locomotive is moving at slow speed. Such derailments usually occur with some one class of locomotives, under certain definite conditions as to degree of curvature and track elevation, and operating conditions peculiar to the locality. Occasionally the second driver will also figure in a derailment. Such derailments, while causing very little property damage, are costly and exasperating. They tie up the line, cause delays and annoyance and frequently require the use of the wrecking outfit because of the heavy locomotives which are usually involved. This discussion, which is based on a study and investigation of a number of such derailments, is made in an attempt to show what might be the causes of such derailments, and where to look for the trouble when these derailments take place.

It is practically impossible to arrive at exact values for the forces and stresses that occur in the locomotive and track, by a method of analysis. This is owing to the varying conditions found and the assumptions which must necessarily be made. Yet this is the only method that the majority of engineers have for arriving at conclusions in regard to such derailments. There are instruments for determining the thrusts exerted by locomotive drivers on the rail, but these instruments are costly. Their use requires a great deal of preparation and time and they require considerable care in handling, as well as in the interpretation of results. Such apparatus is not available to the average mechanical officer for his investigations. Therefore, it is necessary to study the case analytically with the hope of shedding some light on the problem to the end that faulty conditions will be corrected and future derailments prevented.

THIS article is the result of a series of investigations begun by Mr. Beaver, assisted by Mr. Richardson, in the spring of 1919. The original investigation resulted in the determination of a factor which was called the factor of wheel bearing. This factor is the ratio of the weight on the wheel to the vertical thrust which tends to lift the wheel from the rail. When this factor is equal to, or greater than one, the wheel will stay on the rail and when it is less than one, the wheel will climb the rail. The results of the original investigation were incorporated in a thesis, which is now the property of the School of Engineering of The Pennsylvania State College, to which reference has been made in preparing this article. At that time the center of rotation, in the case of a Santa Fe type locomotive, was considered to be at the point of contact of the inside main driver with the rail. Subsequent investigation has shown that the center of rotation varies with different conditions of equipment and track.

The locomotives involved in the derailments which led up to this discussion were of the heavy Mikado and Santa Fe types. The speeds were slow, not over 10 miles per hour, and it was usually the outside leading driver which was derailed. Sometimes it was both the leading and second drivers that climbed the rail. There were instances where the locomotive had traveled considerable distances before the engineman was aware that a derailment had taken place. These derailments took place on curvatures of from about 4 deg. to 12 deg.

In order to simplify this discussion, the writers have chosen to include only the Santa Fe type of locomotive. The principles involved, however, apply equally well to any other type of locomotive. Furthermore, as these derailments took place at low speeds, the conditions were considered to be static rather than dynamic and centrifugal force would therefore have little effect and was not taken into account in this study.

This discussion is intended to be qualitative, rather than quantitative. It is desired to point out the principles rather than to give definite figures for any particular locomotive and for this reason the figures used in this article and the selection of the Santa Fe type are solely for the purpose of illustrating and giving a definite form to these principles.

How a Locomotive Traverses a Curve

Apparently a locomotive rolls around a curve with little effort, but when curve friction is taken into account, train resistance formulas show that the work to be done in curving is a factor to be reckoned with. Suppose a locomotive going east passes around a curve after which it is traveling north. During the time the locomotive has gone around the curve it has rotated about some point in its wheel base through an angle of 90 deg. That is, while it was rolling ahead, it was also slipping sidewise; the treads of the wheels slipping laterally on the tops of the rails. It is evident that there must also have been a longitudinal slipping of some of the wheels, because the distance around the curve on the outer rail is longer

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†Associate editor, *Railway Mechanical Engineer*.

than the distance on the inner rail. These lateral and longitudinal slippages, or their components, must be overcome to get the locomotive around the curve and the work must be done by the flanges. At high speeds, centrifugal force must also be overcome, but its effect is very small at slow speeds. In order to fix these ideas clearly in mind, consider a locomotive without flanges to be traversing a curve on a plane surface without rails, as shown in Fig. 1. The traction of the locomotive if not guided would cause it to move in the direction of the arrow X. But it is desired to make it move in the curved path AB. In order to do this it is necessary that pulling forces be applied at the front and back, as at Y and Z, or pushing forces, as at Y' and Z' or combinations of these forces, at the same time that the tractive force is acting. By regulating the amounts of the forces Y, Y', Z and Z' in conjunction with the tractive force, the locomotive will follow the curved line AB without the use of rails and flanges. Instead of the large forces Y, Y', Z and Z', we could employ a larger number of smaller forces as a, b, c, d, e and f. It will be observed that the forces Y and Z, or the larger number of smaller forces, cause the whole locomotive to rotate about some point in its wheel base and that the location of the point of rotation can be varied by altering these forces.

Now consider that this locomotive, still without flanges, is placed on the track. If the rotating forces are just right, the locomotive will go around the curve safely. The action of the pairs of wheels will be the same as large cylinders which tend to roll at right angles to their axes, as indicated by the arrows in Fig. 2. Thus first, second and third pairs of drivers tend to roll off on a tangent to the curve and leave the rail on the outside of the track and the fourth and fifth pairs of drivers tend to roll over the rail on the inside of the track. So if the guiding forces are removed, or are too small for the work to be done, the locomotive will assume the position shown in Fig. 3.

Position of a Locomotive on a Curve

With these ideas in mind, consider Fig. 4 which shows the position of the drivers of a Santa Fe locomotive on a curve. The solid lines are the position of the locomotive at any instant and the dotted lines at any succeeding instant. The curvature of the track shown in the drawing is exaggerated for clearness.

The locomotive is moving in the direction of the large arrow. The axles are held parallel to each other by the frame and with the possible exception of the main axle, make angles with the radii of the curve, as shown at A and B. The angularities between the axles and the radii cause similar angularities between the flanges and rails, which are commonly termed the striking angles. Thus the wheels roll, with respect to the rails, as shown by the small arrows on each wheel. This shows how the outside number one and two drivers tend to climb over the outer rail and the inside number four and five drivers tend to climb over the inner rail. Furthermore, the striking angles cause the points of contact between the wheels and rail to move ahead of the centers of the outside number one and two and inside number four and five drivers, and back of the centers of the opposite wheels. The locations of the points of contact are on the lines C. The distances from the centers of the wheels to the lines C depend upon the curvature, the length of wheel base and the position of the wheels in the wheel base.

Whether or not there is actually contact between the wheel and rail on the lines C depends upon the curvature of the track and the lateral play between the backs of the drivers and the journal boxes. Any curvature will cause the number one wheel to roll against the outer rail and cause contact at D and any curvature would cause the number two wheel to roll against the rail at E, if the frame of the locomotive did not exert a force to hold it away. It has been found that

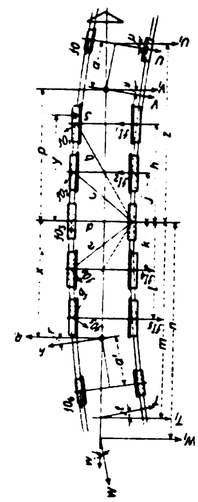


Fig. 5—The Forces and Reactions of a Locomotive When Curving

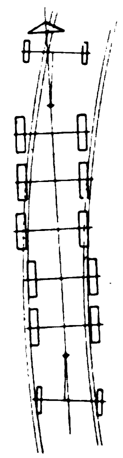


Fig. 2—A Locomotive Without Flanges on a Track

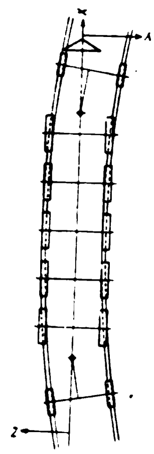


Fig. 3—Position a Locomotive Tends to Assume When the Guiding Forces Are Removed

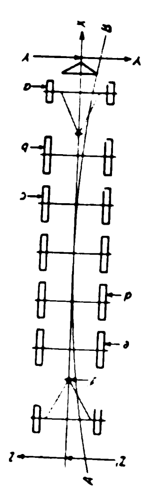


Fig. 1—A Locomotive Without Flanges on a Plane Surface Without Rails

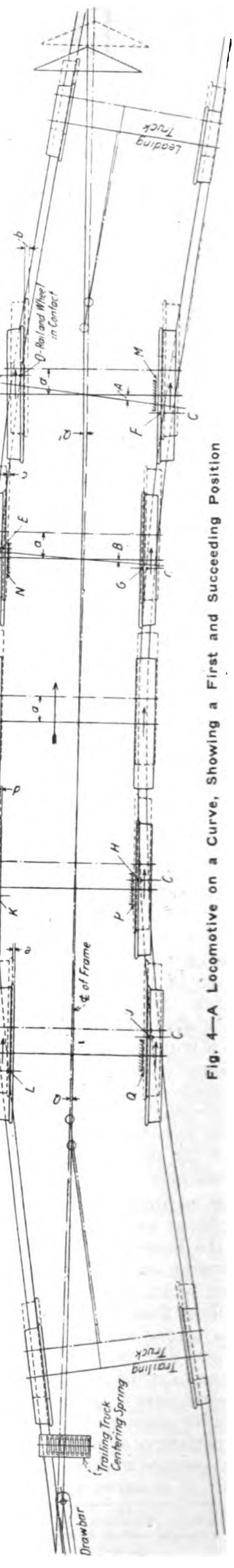


Fig. 4—A Locomotive on a Curve, Showing a First and Succeeding Position

a locomotive just out of the shop, with the lateral taken up, will have contact between the flange of the second driver and the rail at E up to about four degrees of track curvature, after which there is clearance at E. This explains why derailments do not take place so commonly under four degrees, for below that curvature, there are two driving wheel flanges doing the work of guiding instead of one. But when the departure of curvature becomes too great for the driving box lateral, as it does from about four degrees upward, the flange is pulled away from the rail at E, the assistance that the number two flange has been giving is withdrawn and the number one flange must take on the extra load. Naturally, there is clearance at the opposite points shown at F and G, for these drivers tend to roll away from the inside rail. In spite of the fact that the inside number four and five drivers tend to roll over the inside rail toward the inside, an observation of locomotives on curves shows there is clearance at H and J, as well as at K and L. We naturally expect a

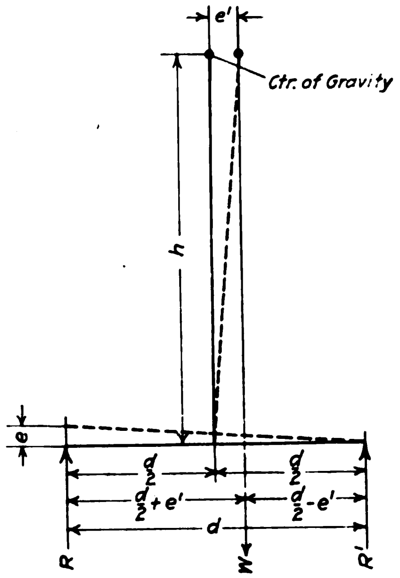


Fig. 6—Diagram Showing the Effect of the Elevation of the Outer Rail

clearance at K and L due to the direction in which these wheels roll with respect to the outer rail, but the clearance at H and J can only be explained by the fact that the center of rotation must be somewhere ahead of the number four drivers. It may be noted, as a deduction, that the maximum curvature which the locomotive will take without complete binding is that which will cause contact at the points D, L, G and H.

Because these derailments give trouble when the number two flange does not bear against the outer rail, this study has been limited to that condition. The outside number one hub bears against the frame, putting all the lateral in the number one pair of drivers at M, while the frame rotates in the direction of the curve. This rotation of the frame causes it to bear against the inside number two and outside number four and five hubs, which places the lateral in those drivers at N, P and Q, respectively.

Succeeding Positions of a Locomotive on a Curve

Consider the locomotive in Fig. 4 to have moved the distance a to the position shown by the dotted lines. After the locomotive has fully entered the curve, other conditions being equal, the contacts and clearances at the hubs, will remain constant until the locomotive starts to leave the curve. It will be observed that while the locomotive has moved ahead the distance a, the number one drivers have moved to the right the distance b; the number two drivers have moved to the right the distance c; the number four drivers have moved to the left the distance d, and the number five drivers have moved to the left the distance e. Thus it will be observed that a locomotive does not simply roll around a curve, but that it both rolls and slides around the curve with a sidewise slipping of the wheels, and that for each longitudinal advance there is a corresponding lateral slipping. This is nothing more nor less than a lateral rotation of the locomotive, the rolling of the wheels and longitudinal advance having little to do with it, except to make the necessary rotation. This rotation is shown by the positions of the center lines of the locomotive in Fig. 4, the center of the locomotive having been rotated through the angle Q'.

The Center of Rotation

The center of rotation varies for different types of locomotives, curvatures of track, speeds and locomotive and track conditions. It will vary even for any given locomotive and curvature with the slightest amount of variation of speed, track elevation, surface and alinement, as the throttle is opened or closed, or as the brakes are applied or released. However, for the conditions selected, it may be definitely located on the inner rail, approximately under the main driving wheel. Owing to the elevation of the outer rail and low speed with the absence of centrifugal force, the most slipping will occur under the outer drivers and not the inner, as the outer drivers carry less load than the inner for these conditions. Therefore rotation takes place about some point on the inner wheel base. Furthermore, if the point of rotation is at or back of the contact point of the number four driver, the clearance at H would become zero, as this wheel rolls in the direction of the arrow, which it does not do in practice. Therefore the point of rotation is somewhere ahead of the number four driver, and it will have to be an appreciable distance ahead of this driver to maintain the clearance at H. Finally, if the point of rotation is appreciably ahead of the main driver, the distance from the center of rotation to the contact point of the number one driver at D would be less than the distance from the center of rotation to the contact point of the number five driver at L, so that a given lateral movement at D would produce a greater lateral movement at L taking up the clearance at L, which again is not borne out in practice. Therefore the center of rotation must be near the inside main driver. A small variation in the location of this point will not affect the principles involved nor materially affect the numerical calculations. Thus for the sake of simplifying both the analysis and computations, this point will be considered as being at the center of the tread of the inside main driver.

Forces to Be Overcome in Rotating

We have seen that the rotating forces must overcome the lateral slipping of all the driving wheels, or the diagonal components thereof, except that of the inside main driver, about which the rotation of the locomotive takes place. There is also a longitudinal slipping of the outer wheels, due to the fact that the distance around the curve on the outer rail is longer than the inner and that the outer wheels carry a lighter load. This longitudinal slipping, or its diagonal component, must be overcome as well. The trailing truck, or the leading truck, when the locomotive is backing, also exerts a force opposite to the direction of curving, and this too, must be overcome. Finally, the pull of the drawbar has a component which adds its share to the already heavy burden of the rotating forces. In all of this it must be kept in mind that centrifugal force is not considered to be a factor at these low speeds. Each of the forces to be overcome may be analyzed and evaluated.

These forces can be more clearly understood by referring to Fig. 5. If O_1 is the weight on the outside number one driver, O_2 the weight on the outside number two driver, I_1

the weight on the inside number one driver, etc., and f the coefficient of friction between the wheel and rail, then the forces $f\ O_1$, $f\ O_2$, $f\ I_1$, etc., are the forces required to cause sliding of the wheels, longitudinally in the case of the outside main driver, laterally in the cases of the inside number one, two, four and five drivers and both longitudinally and laterally, or diagonally, in the cases of the outside number one, two, four and five drivers.

Driving Wheel Friction

In arriving at the loads on the drivers, we must bear in mind that the elevation of the outer rail causes the center of gravity of the locomotive to the thrown toward the inside of the curve, thus taking weight off the outside wheels and putting additional weight on the inside wheels. This can be understood from Fig. 6, in which the solid lines show the locomotive when horizontal and the dotted lines show the locomotive when on a curve with the elevation e. Suppose h to be the height of the center of gravity above the top of the rail and d the distance from center to center of the tops of the rails. Then $\acute{e}$, the distance the center of gravity will move toward the inside of the curve, is $\frac{eh}{d}$. Also the reactions R and R' due to the load W being off center will be

$$R = \frac{w\left(\frac{d}{2} - e'\right)}{d} \text{ and } R' = \frac{w\left(\frac{d}{2} + e'\right)}{d}.$$

These wheel loads are to be used for O and I, respectively.

In selecting a value for the coefficient of friction f, a study of the data and tables given by various authorities, and also of the results of investigations made at The Pennsylvania State College shows that it varies from .10 to .41, and that a fair value for steel tires on steel rails would be about .20. In selecting this figure, it was borne in mind that the coefficient of friction would be less for a revolving wheel than for a stationary wheel, as shown by the fact that a plug gage can be slipped more easily into a ring gage if it is revolved at the same time it is pushed in. It may also be noted here that the coefficient of friction of rest is greater than that of motion, and that this coefficient decreases in value as the speed increases. We would, therefore, naturally expect derailments to occur on curves of moderate curvature, say up to about 12 degs. The speed of lateral slipping, for any given locomotive speed, increases with the curvature, and therefore the coefficient of friction of lateral slipping for the higher curvatures, being less, does not cause such a high side thrust of the outer wheel.

Trailing Truck Action

Trailing trucks are of various types, but suppose we have one of the sliding type with a centering spring. This spring is compressed on a curve, and exerts a pressure on the locomotive frame toward the inside of the curve. From the known dimensions of the spring we have the diameter of the steel d, the mean radius of the coil r and the number of coils n. Also from the conditions of the curvature, we know the deflection F. Then from the formula $T = \frac{FGd^4}{64\ nr^3}$ we are able to calculate the force T, which is exerted by the spring, taken the modulus of torsional elasticity, G, at 12,500,000. This force is not at right angles to the frame but is transmitted to the frame through the usual ball and socket connection. Therefore we must consider the component normal to the frame, which is $T_1 = T \cos t$. Trailing trucks of the rocking or other types would be considered in a similar manner, except that in these types the load is applied on the center of the truck, whereas when centering springs are employed, the load is applied at a considerable distance back of the truck center.

Effect of the Drawbar Pull

When the locomotive is pulling a train or even the tender, there is a side thrust to be considered, the intensity of which will depend upon the curvature and the actual drawbar pull. We shall include this factor in the study and set for it a figure based on a nominal drawbar pull of 30,000 lb. In making investigations this factor will have to be studied carefully in order to be evaluated properly. Referring to Fig. 5, the side thrust of the drawbar pull is $W_1 = W \tan w$.

Moments of Forces to Be Overcome

Thus we must overcome the forces fO_1, etc., fI_1, etc., T_1 and W_1, the intensities of which have just been analyzed.

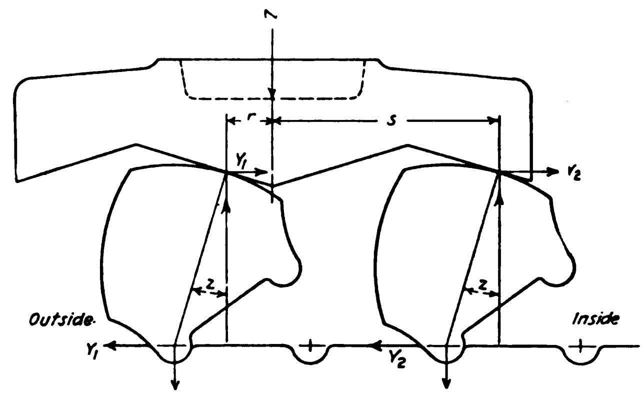


Fig. 7—Reactions in the Leading Truck

Since we have considered rotation to take place about the inside main driver, the moment arms of these forces are b, c, d, etc., as given in Fig. 5. Summing up these factors, in order to cause the locomotive to rotate about the inside driver, we must exert sufficient turning moment to overcome these resisting moments which are

$$bfO_1 + cfO_2 + dfO_3 + efO_4 + gfO_5 + hfI_1 + jfI_2 + kfI_4 + lfI_5 + mT_1 + nW_1$$

Overcoming the Reactions

Opposed to the above forces are reactions which must cause sufficient turning moments to balance those of the resisting forces if a derailment is not to occur. First of all, we have the guiding reaction of the leading truck wheel flange and then the reaction of the leading driving wheel flange. Owing to the conditions already assumed, there are no other flange reactions. Assisting the two flange reactions are the lateral components of the side thrusts of the leading truck radius bar pin and of the trailing truck radius bar pin. Truly the reactions are few compared to the resisting forces and consequently they must be high in numerical value to meet the work they are called upon to do. Referring again to Fig. 5, the leading truck reaction is U with its lateral component U_1; the leading driving wheel reaction is S; that of the leading truck radius bar center pin is V, with its lateral component V_1, and that of the trailing truck radius bar pin is R, with its lateral component R_1.

An Analysis of the Reactions

As in the case of the trailing truck, there are also various kinds of leading trucks; and for purpose of analysis one of the constant resistance, rocker type has been selected. Referring to Fig. 7, let the load on the truck be Z. This load will then have the vertical reactions at the rockers of $Z_1 = \frac{Zs}{r+s}$ and $Z_2 = \frac{Zr}{r+s}$, respectively. The horizontal components of the reactions are $Y_1 = Z_1 \tan z$ and $Y_2 = Z_2$

tan z respectively, which, added together, equal U in Fig. 5. U has its lateral component which is $U_1 = U \cos u$. The reaction of the leading truck radius bar pin causes the wheels to follow the curve radially. In order to do this the reaction of the pin must be sufficient to cause the slipping of one of the wheels, at least when the coning is not precisely right, as is generally the case, all because the outer and inner rails of the curve are not the same length. Because the outer wheel carries the lesser weight, it is the one to slip and the force required to slip it is fO. If d is the distance from center to center of the rails, as in Fig. 6, and a the distance from the pivot pin to the center of the truck as in Fig. 5, then by taking moments about the inside wheel, the reaction is $V = \frac{fOd}{a}$ and its lateral component is $V_1 = V \cos v$.

The reaction of the trailing truck radius bar pin is due to the same cause as the reaction of the leading truck radius bar pin and may be found in a similar manner. Thus let d again be the distance from the center of rail head and a' the distance from the pivot pin to the center of the truck. Then by taking moments as in the case of the leading truck, the value of the side thrust is $R = \frac{dfO_6}{a'}$ and its lateral component is $R_1 = R \cos r$. The reaction of the leading driver will be considered as the unknown and when once determined, it will enable us to tell whether or not that wheel will stay on the rail. Thus by using the moment arms given in Fig. 5, in a manner similar to that used for the resistances, the combined moments of the rotating reactions are $zU_1 + yS + xR_1 + pV_1$, in which S is unknown.

The Vertical Reaction

This horizontal thrust S has a vertical reaction S_1 which is opposed by the weight on the driving wheel. If the weight is not sufficient to overcome the reaction S_1, a derailment will result. The relation of the wheel and rail is shown in Fig. 8, in which the rail is curve-worn, as that is usually the condition in which the rail is found when a derailment takes place. The relation is similar to that of an inclined plane, the thrust S producing the normal reaction s and the vertical reaction S_1. If the angle of incline is i, then $S_1 = S \cot i$. When the wheel is at rest, then the reaction S_1 is the only one which the weight of the wheel must overcome. But when the wheel is rotating, there is an additional vertical reaction to be overcome, which arises out of the friction between the flange and rail due to the normal pressure s. The contact point being at the distance q ahead of the center of the wheel, the friction at this point would cause the wheel to tend to rotate about the bearing point, rising off the tread, so that some of the weight of the wheel is required to hold it down against this friction. This can be better understood by recalling that the wheel bears against the rail at an angle, causing it to nose into the rail and tending to make it roll up the inclined plane and go over the rail. This friction, due to the binding action, high bearing pressure and small area of contact, is very high, and its cofficient, f', may safely be put at .35. The normal force $s = \frac{S}{\sin i}$, and the friction is then $f's$. This friction then has the vertical component $s_1 = f's \sin i$. Therefore the vertical reaction which must be overcome by the weight on the wheel while rotating is $S_1 + s_1$.

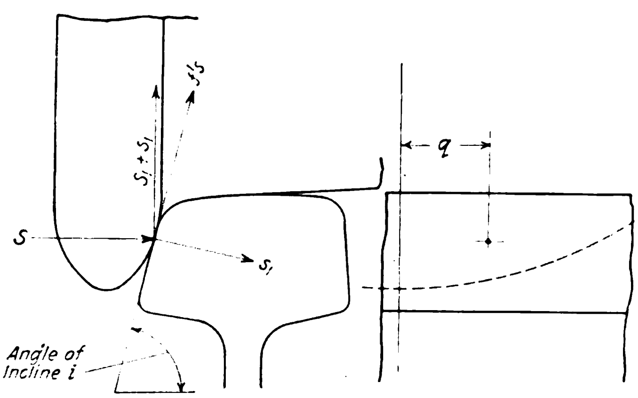


Fig. 8—Relation of the Horizontal to the Vertical Forces at the Wheel

The Factor of Wheel Bearing

The ratio of the weight on the wheel to the vertical thrust which tends to lift the wheel may be called the *factor of wheel bearing*. When this factor is equal to or greater than 1.00, the wheel will stay on the rail and when it is less than 1.00, the wheel will climb the rail. As soon as the flange gets on top of the rail, the factor of wheel bearing increases, but it is too late and the longitudinal rolling carries the wheel over. Sometimes after the leading driver has left the rail, the factor of wheel bearing of the second driver becomes sufficiently low to cause it also to climb over the rail, but such cases, while reported occasionally, are not nearly as common as derailments of the leading driver only. One would naturally suppose that when the first driver left the rail, the additional weight thrown upon the second driver would give it the necessary factor of wheel bearing to keep it on the track, which it does in most cases.

[This discussion will be continued in the January issue, in which a practical application of the factor of wheel bearing will be given.—EDITOR.]

Locomotive Resistance and Tractive Force—A Correction

An article on Locomotive Resistance and Tractive Force by Kiichi Asakura, mechanical engineer, Japanese Government Railways, Tokio, Japan, was published in the September, 1924, issue of the *Railway Mechanical Engineer*. The following corrections should be made to the formulas on page 524, which read thus:

$$w = 2.2\ 0.015\ v \text{ per metric ton.}$$

and

$$w = 5.\ 0.054 \text{ per long ton.}$$

These should read

$$w = 2.2 + 0.015\ v \text{ per metric ton.}$$

and

$$w = 5 + 0.054\ v \text{ per long ton,}$$

respectively.

The following correction should also be made in the three formulas for boiler efficiency on page 525 where the quantity $\left(\frac{G_4}{H}\right)$ is given. This should read $\left(\frac{G}{H}\right)^4$. The last formula shown on this page which reads

$$\frac{\text{Cylinder dia. in.} \times \text{stroke, ft. or in.}}{\text{Dia. of driver, ft.}} = \frac{d^2l}{D}$$

should be

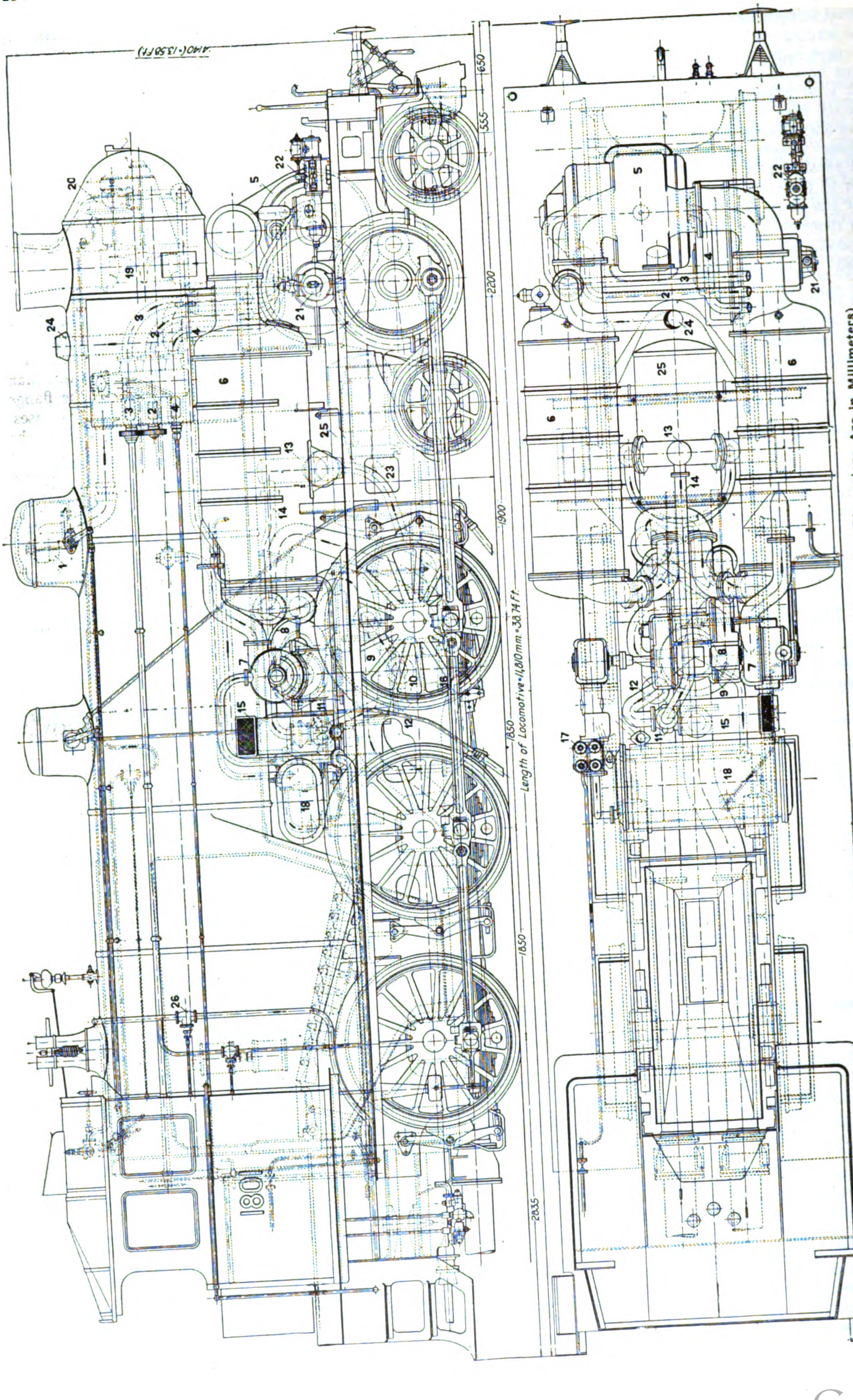
$$\frac{(\text{Cylinder dia. in.})^2 \times \text{stroke, ft.}}{\text{Dia. of driver, ft.}} = \frac{d^2l}{D}$$

and the formula

$$\frac{\text{Grate area sq. ft. or sq. in.}}{\text{Cylinder volume (one cyl. cu. ft. or cu. in.)}}$$

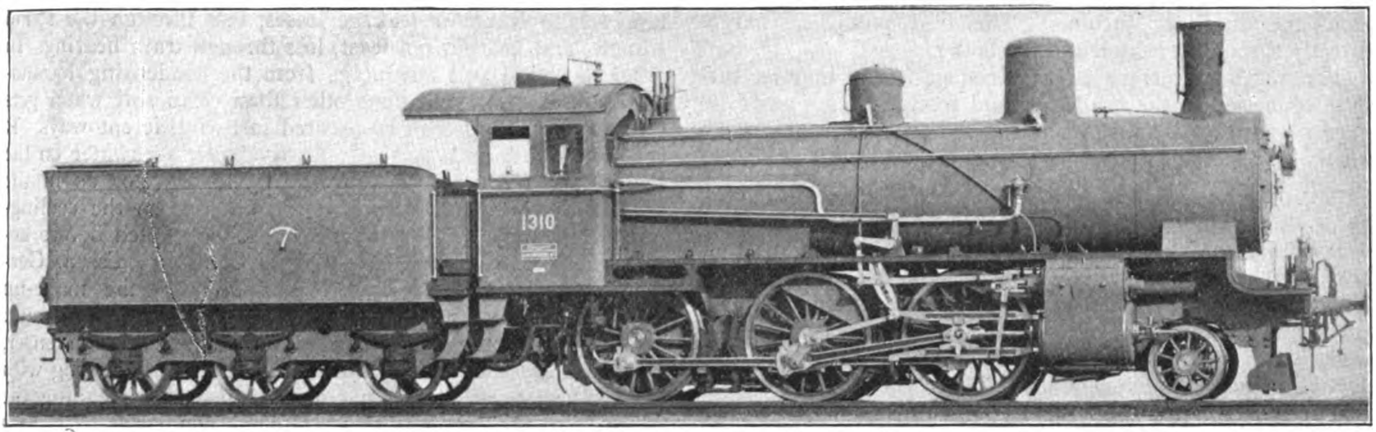
should be

$$\frac{\text{Grate area sq. ft.}}{\text{Cylinder volume (one cyl. cu. ft.)}}$$



Plan and Elevation Drawing of the Zoelly 1000-hp. Turbo-Locomotive (Dimensions Are in Millimeters)

1. Main governor valve.
2. Steam valve for running ahead—normal.
3. Steam valve for running ahead—overload.
4. Steam valve for running astern.
5. Main turbines for running astern and ahead.
6. Condensers.
7. Turbine driving condenser auxiliaries.
8. Reduction gear.
9. Circulating water pump.
10. Centrifugal pump—water for air ejector.
11. Water-jet air ejector.
12. Water delivery pipe from pump 10 to ejector.
13. Air collector for air from condensers.
14. Air suction pipe from collector to ejector.
15. Air separator.
16. Condensate pump.
17. Feed pump.
18. Feedwater heater.
19. Furnace fan.
20. Turbine for driving the furnace fan.
21. Oil pump for main turbines.
22. Stand-by oil pump.
23. Oil cooler.
24. Atmospheric exhaust.
25. Air storage for automatic air brake.
26. Live steam for turbine on recooler.



The Original Locomotive Before Its Conversion to Turbine Drive

Mogul Locomotive Converted to Turbine Drive*

Test Shows Greater Operating Economy and Increased Capacity with the Same Boiler

By H. Zoelly

Chairman, Escher Wyss & Co., Zurich, Switzerland

ESCHER WYSS & CO., Zurich, Switzerland, in conjunction with the Swiss Locomotive Works, Winterthur, has successfully converted a mogul type reciprocating locomotive into a turbine driven condensing locomotive. The principal change, in general appearance, as compared with the original locomotive has been the replacement of the cylinders by a turbine. The original boiler, equipped with a Schmidt superheater, has been provided with a turbine-driven fan arranged in the front part of the smokebox as a substitute for the draft produced by the exhaust steam of the reciprocating engine.

The Main Turbines

The new locomotive was constructed for the same performance as the old one, so that the six-stage impulse Zoelly turbine for running ahead was designed to give 1,000 hp. at the crankpin. The back-up turbine consists of a simple compound wheel and is contained in the same casing as the ahead turbine. The turbine rotor, comprising both the ahead and back-up wheels, is made out of a solid block, the blades being inserted in slots in the wheel rims. The turbine drives through a double-reduction gear (the first reduction 1:7 and the second 1:4.1), a jack-shaft carrying the crank-pins and the drive to the wheels being obtained by connecting rods.

The turbine casing with the reduction gear, intermediate shaft, jackshaft, and all bearings are mounted on a one-piece steel casing which is riveted to the locomotive frames. The turbine is placed in front of the boiler, its axis parallel to the locomotive axles.

Steam admission to the ahead or back-up turbines is controlled by valves which are operated from the enginemen's cab. For running ahead two groups of nozzles have been provided in the first guide wheel, one allowing the passage of about 11,000 lb. of steam when fully open, and the other for 4,400 lb. One or the other of the valves, or both, is fully open, according to the load. Intermediate quantities are obtained by throttling with the main governing valve. Only one valve which allows a total of 15,500 lb. of steam to pass, has been provided for running backwards. Smaller quantities are likewise obtained by throttling down with the main governing valve. The efficiency of the back-up turbine is lower than that of the ahead turbine for a locomotive usually runs ahead. Backing up is only provided for switching maneuvering, or for use in cases of emergency where a smaller amount of power is required.

The maximum traveling speed of the locomotive is 47 miles per hour and is limited by the type of locomotive. The driving wheels have a diameter of 60 in. At 47 m.p.h. the turbine makes 7,500 r.p.m. The turbine speed is of course, proportional to the traveling speed. When running ahead the back-up wheel rotates in a vacuum, as is common practice in marine propulsion. The wheel friction for the simple back-up turbine is small, and the losses are therefore insignificant.

The Condensers and Auxiliaries

The steam passes in about equal quantities from the exhaust end of the turbine, in both the ahead and the back-up turbines, to condensers placed longitudinally on each side of the boiler. These condensers are water cooled and are of the surface type.

All auxiliaries of the condensing plant are driven by one small turbine which revolves at 9,000 r.p.m. This speed is reduced to 1,200 r.p.m. through a reduction and bevel gearing and drives a vertical shaft carrying the circulating-water, air, and condensate pumps. The circulating pump takes water from the tender and forces it through the condensers and back again to the recooler. The air pump discharges at a pressure of about 75 lb. to a water-jet air ejector which communicates with the two condensers. It is designed so that the air in the air separator can escape into the atmosphere and the water return to the suction side of the circulating pump.

The condensate from the condensers is led to the condensate pump, which latter discharges at about atmospheric pressure into the feed pump. The latter is placed on the side platform of the locomotive. It is a reciprocating pump running at 59 r.p.m. and is driven through a second reduction

*Abstract of paper presented before the annual meeting of the Railroad Division of the American Society of Mechanical Engineers. The paper also appeared in the November issue of Mechanical Engineering, published by the society.

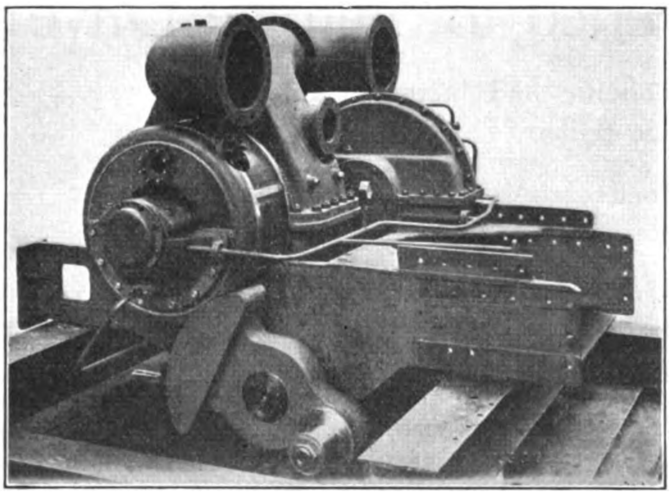
from the auxiliary turbine. The feed pump discharges directly through a heater into the boiler.

The auxiliary turbine is a three-stage Zoelly impulse turbine connected to the condenser and receives steam at 11 lb. gage pressure. Exhaust steam is used in this turbine from a back-pressure turbine which drives the ventilator of the recooler.

The Forced Draft Fan

Special means had to be provided for producing the firebox draft, as the exhaust steam was no longer available. The locomotive was first equipped with a forced draft for producing pressure under the grate. After a long series of tests, however, it was found necessary to change over to the suction principle.

The fan is of the centrifugal type, provided with a spiral casing, and is capable of producing a vacuum in the smokebox of 8.2 in. of water. A maximum of 280 cu. ft. of flue gases can be discharged per second when running at 1,500 r.p.m. The fan is driven by a small turbine through a gear



The Turbine Casing and Balanced Crank

with a transmission ratio of 1 to 6. The turbine receives live steam and exhausts with a back pressure of about 7 lb. gage to the feedwater heater. The admission of steam to the turbine is regulated by a valve which is also operated from the enginemen's cab. The exhaust steam from the turbine which drives the fan is passed into the heater as there is a certain ratio between the quantity of feedwater and the exhaust steam from that turbine. If for some reason there should be no water in the heater and the steam could not condense, a safety valve opens a connection from the heater to the condenser. The condensate of the heater steam always escapes directly to the condenser and thus goes to the boiler along with the condensate of the main circuit.

This design lacks the advantage of the usual draft producer, i.e., the proportioning of the draft to the quantity of steam required in the main turbine. This, however, can be realized on condensing locomotives by bleeding steam from the main turbine.

The design of the Westinghouse air pump does not quite suit the different operating conditions of the turbine locomotive as the exhaust steam is lost and cannot be used on account of the oil it contains. In future designs the natural course will be to employ a rotary pump, which can be driven by the same auxiliary turbine that drives the condensing auxiliaries, thus returning all steam to the boiler.

The Boiler Feedwater

Theoretically the condensing locomotive does not need any additional water for boiler feeding, as the water in the boiler is working on a closed circuit. It is practically impossible, however, to eliminate leakage losses, loss through the steam whistle, and last but not least, loss through train heating. In order to obtain full advantage from the condensing locomotive it is essential that none other than clean soft water gets to the boiler. This can be assured in two different ways. It is possible to have a special tank for boiler feedwater on the tender, the feeding being effected by an injector as in the case of the ordinary locomotive, or water from the cooling-water tank may be used, which should be treated before being sent to the boiler. The Krupp Company, Essen, Germany, which holds a Zoelly license, cleans the make-up water by sending it to a small evaporator. The feedwater evaporated in the evaporator escapes into the condenser, where it condenses and it is then sent to the boiler along with the condensate of the main circuit. Instead of leading the steam from the evaporator direct to the condenser, it is also possible to send it to a low-pressure turbine, or to a certain stage of the machine, thus doing useful work.

Neither of these two solutions has been resorted to on the experimental locomotive. The cooling water is used direct for boiler feeding, and is fed by the steam injector when necessary.

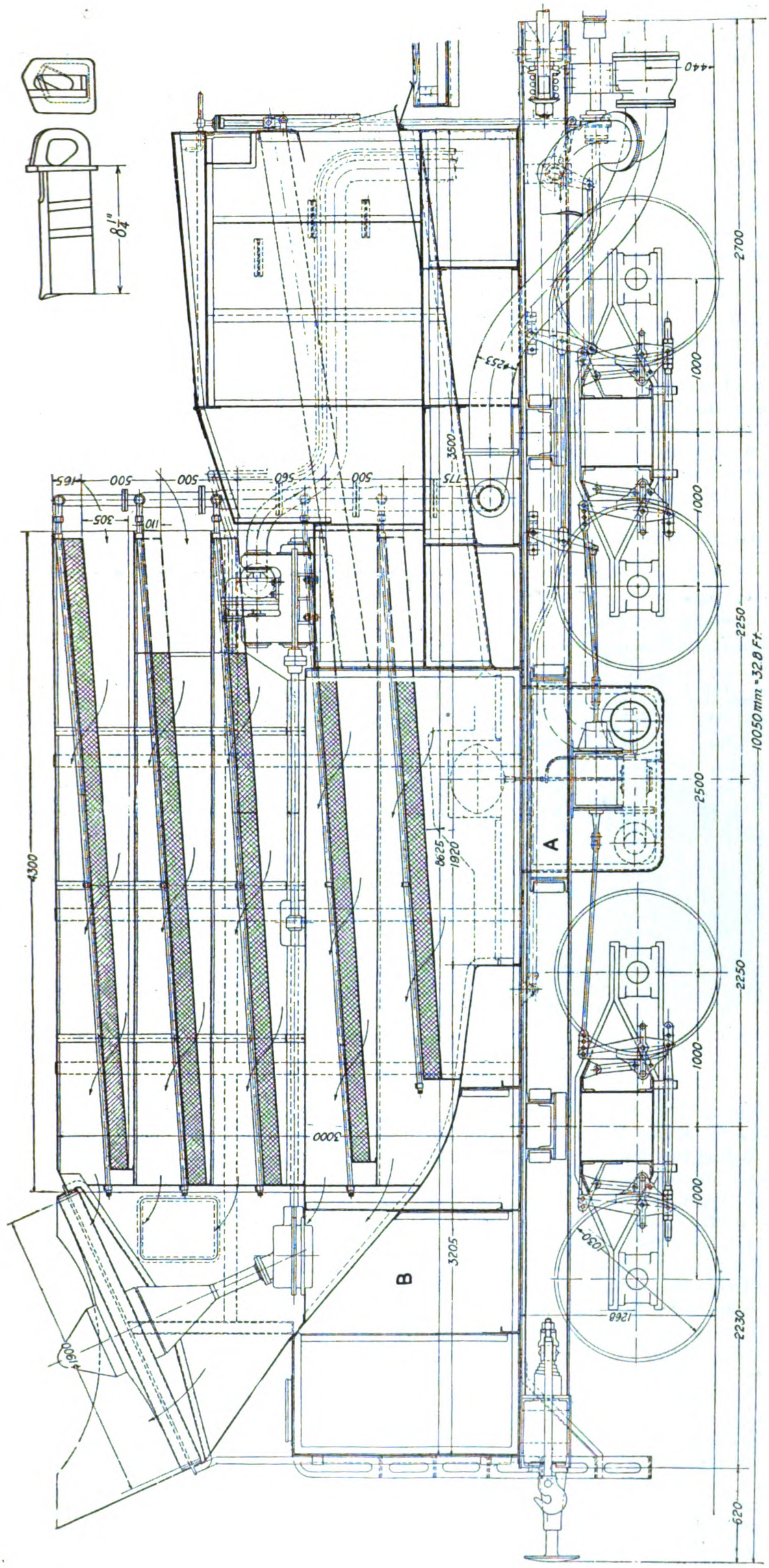
System of Lubrication and Recooling

Each turbine has its own lubricating system, comprising an oil tank and a geared pump driven from a shaft of the reduction gear. Gears and bearings are under forced lubrication, the oil for the main turbines passing through an oil cooler which is connected with the cooling-water circuit of the condensers.

The most vital part of the condensing locomotive, working with water as a refrigerating medium in the condenser, is the recooler. All the heat units taken from the steam in the condenser go to the cooling water, which of course, has to be recooled in order that it may be used in a cyclic process. The recooler is a separate vehicle, taking the place of the usual tender, and it provides room for coal and make-up water for boiler feeding. It works on the vaporization principle, air being brought into intimate contact with the water to be cooled, which heats it and saturates it with water vapor. The heat to be absorbed in such manner is enormous, amounting in the case of the 1,000-h.p. experimental locomotive to about 5,760,000 B.t.u. per hour, and increasing in proportion for larger locomotives.

The recooler comprises a certain number of water and air elements working in parallel. Each element consists of a wrought-iron channel of rectangular cross-section. This channel is divided diagonally into two halves in the longitudinal direction by means of perforated trays containing Raschig rings; i.e., small tubes of about equal length and diameter. The water to be cooled is led to these trays by tubes which act as sprayers, the air passing in counterflow. The cooling elements are so disposed that the natural current of air produced by the traveling train can enter the cooling element direct. A fan produces a sufficient current of air when the train is stationary or traveling at a very slow speed, and also augments the normal current when traveling at ordinary speeds. It is driven through a gear by a small back-pressure turbine, as previously mentioned. Admission of steam to the turbine is controlled by means of a valve from the enginemen's cab.

The cooled water flows from the cooling element back into a tank, whence it is again drawn into the circulating pump. As a certain amount of water is evaporated in the process it becomes necessary to add a corresponding amount in order to keep the circulating quantity constant. There is provided for this purpose, a large storage tank on the tender, which communicates with a suction tank by means of floaters. The water in the tender need not necessarily be pure as it does not enter the boiler nor come into contact with such parts as could seriously affect the working of the plant.



Elevation Drawing of the Recooler for the Zoelly 1000-hp. Turbo-Locomotive (Dimensions Are in Millimeters)

Space is provided in the tender for 11 tons of coal and 1,440 gals. of water.

The recooler car and locomotive are coupled in the usual way. The connections for both the suction and discharge pipes of the cooling-water system are made by means of sliding ball-and-socket joints. These joints allow the tender to be uncoupled from the locomotive upon removing the coupling bolts. Connections for live and exhaust steam from the turbine which drives the fan of the recooler are only of small dimensions and are made by flexible pipes.

Theoretical Considerations

The Recooler—The vacuum obtainable determines the calculation of the turbines and auxiliaries; i.e., the better the vacuum, the greater the total heat which can be transferred to useful work. It is known from stationary plants that with surface condensers the vacuum depends directly on the cooling-water temperature. In the case of the condensing locomotive the vacuum, therefore, depends upon the temperature to which the cooling water can be lowered in the recooler.

The maximum temperature which the air going through the recooler can attain is that of the warm cooling water. If it be assumed that the air at this maximum temperature is fully saturated with water vapor, then the difference in total heat between the air entering and that leaving the recooler is identical with the amount of heat withdrawn from the water. When a turbine is working against different vacua it is possible, assuming definite initial steam conditions and constant turbine efficiency, to calculate the amount of heat which has to be extracted from the steam in the condenser or, what is the same thing, from the cooling water in the recooler. If it be further assumed that the vacuum in the turbine exhaust corresponds to the water-vapor tension of water at a temperature which is 41 deg. F. greater than the cooling water leaving the condenser, we can calculate the amount of air necessary to obtain a certain vacuum for a given quantity of steam. This calculation gives 59 deg. F., for cooling air and 70 per cent for saturated. The air necessary for cooling is delivered by a fan. Assuming a

constant surface area for the cooler for all the different vacua, the resistance through the cooler would of course, increase with the quantity of air, and the power required for driving the fan would augment with exceeding rapidity with better vacua. A long series of tests has shown that for full load the vacuum will be somewhere near 90 per cent, which of course, would only apply to maximum loads. On partial loads the vacuum would increase on the amount of steam sent to the condenser being less.

The Zoelly system of cooling involves the necessity of having a condenser and recooler, but affords important advantages. The co-efficient of heat transmission from steam to water in a surface condenser is about 490 B.t.u. per deg. F. per sq. ft. per hr., whereas that for air-cooled condensers from steam to air is only a trifle over 8 B.t.u. The surface of the air condenser must, therefore, be 60 times that of a water-cooled condenser. This makes it possible to have on the Zoelly locomotive, both condenser and turbines, on the same truck as the boiler, thus overcoming all difficulties involved in having vacuum connections between the tender and locomotive. The relatively small vacuum space is easily kept airtight, while the system further allows of the locomotive's being the real driving part, thus adhering to this extent to the old and conventional design.

It was, of course, impossible to calculate the recooler, and very extensive tests were necessary to clear up the very complicated relationships and to get the data for actual design. The complicated nature of the task of finding the most economical design; i.e., getting the maximum of cooling effect for a given surface with the minimum of weight and driving power, will be seen from the numerous variable factors; viz., material of the filling bodies, height, quantity of water, velocity of the air, distribution of water, water and air temperatures, etc. As a result of all tests it was found that for average conditions, that is, air 59 deg. F., cooling water 122 deg. F., corresponding to about 85 per cent vacuum, a cooling effect of 44,260 B.t.u. per sq. ft. per hour is obtained.

The Main Turbine—Superheated steam is used for turbine driven locomotives in any case, as this gives the highest efficiency. So long as it is necessary to use the conventional type of boiler it will scarcely be possible to assume other steam conditions than those obtaining for ordinary locomotives, say, 215 lb. pressure and 662 deg. F. The vacuum has been fixed in the preceding paragraphs and the desired output is given, so that, as variable factors in the turbine calculations there are the turbine speed, the wheel diameters, and the number of stages. These elements have to be chosen so that the efficiency will be as high as possible. On the locomotive we are limited in the matter of wheel diameters as well as in the number of stages. If these are determined the speed is dictated, any departure from which would mean a certain loss in efficiency, which within relatively wide limits, is not of the utmost importance. The turbine speed determines the gear ratio and dimensions. For normal conditions the turbine speed ranges from 6,000 to 8,000 r.p.m., but it also depends upon the maximum speed the train can attain, this in turn being limited by the stresses allowed.

A locomotive turbine has to be calculated not only for one particular speed and one load, as is usually done for stationary plants, but for different quantities of steam flow and for different speeds for each steam flow, in order to obtain full information as to the performance of the locomotive. For running astern a sacrifice in efficiency is admitted on account of the extreme limitation of space. The only point to consider is that sufficient initial torque must be available for accelerating the heaviest of trains.

The Auxiliary Turbines—The limitation in size and weight is very important, but efficiency is also exceedingly important. Small wheel diameters call for multiple stages and the turbine would thus be too long. In order to overcome this difficulty several turbines are connected in series. This arrangement in conjunction with high running speeds (9,000 to 10,000 r.p.m.) satisfies the demand for high efficiency combined with small dimensions.

TABLE I—COMPARATIVE STEAM AND COAL CONSUMPTIONS OF DIFFERENT LOCOMOTIVE TYPES

	Piston locomotives, non-condensing				Piston locomotives, condensing. Superheated-steam			Turbo locomotive. With feedwater heating		
	Superheated-steam simple 2-cyl.		Superheated-steam 4-cyl. compound							
	Without preheating	With preheating	Without preheating	With preheating	Simple. Without preheating	Compound. With preheating	Without preheating	With steam	With smoke gases	Preheating feedwater and combustion air
Boiler pressure, lb. per sq. in, abs.	213	213	213	213	213	213	213	213	213	213
Pressure at steam chest, lb. per sq. in. abs.	199	199	199	199	199	199	199	199	199	199
Temperature in steam chest, deg. fahr.	572	572	572	572	572	572	662	662	662	662
Exhaust pressure, lb. per sq. in. abs.	14.2	14.2	14.2	14.2	2.13	2.13	2.13	2.13	2.13	2.13
Steam per i.hp.-hr. (including all auxiliaries), lb.	16.97–16.28	16.97–16.28	16.5–15.61	16.5–15.61	13.83	11.55	10.59	11.08	11.08	11.08
Saving in steam consumption compared to simple locomotive working with superheated steam, non-condensing, lb.	0	0	0.47–0.67	0.47–0.67	3.14–2.45	5.42–4.73	6.38–5.69	5.89–5.20	5.89–5.20	5.89–5.20
Do., per cent	0	0	2.76–4.1	2.76–4.1	18.5–15.1	31.9–29.0	37.6–35.0	34.7–31.9	34.7–31.9	34.7–31.9
Total heat required in boiler per hp.-hr., B. t. u.	44,860–41,680	33,830–32,470	36,850–34,880	32,910–31,140	30,410	25,510	20,120	19,510	17,980	16,410
Coal consumption (heating value of 11,700 B. t. u. assumed), lb. per hp.-hr.	3.23–3.10	2.88–2.77	3.14–2.97	2.81–2.52	2.60	2.18	1.72	1.67	1.54	1.40
Saving in coal compared to a simple locomotive working with superheated steam and feedwater heating, lb.	—0.35 to —0.33	0	—0.26 to —0.20	0.07-0.25	0.28–0.17	0.70–0.59	1.16–1.05	1.21–1.10	1.34–1.23	1.48–1.37
Do., per cent	—12.4 to —12.1	0	—9.3 to —8.9	2.43-8.9	9.3–5.65	24.1–21.0	40.0–38.0	41.8–39.5	46.5–44.4	51.1–49.2

Feedwater Heating—The heat contained in the smoke gases has long since been utilized in stationary plants, the economizer being a very well known device. Several feedwater heaters of this type have been tried for locomotives, but without success. The draft available in ordinary locomotives is not sufficient to overcome the additional resistance of such a heater. In turbine driven locomotives, however, where the draft has to be produced artificially, this difficulty does not present itself and, therefore, waste-gas feedwater heaters can be employed to advantage. The gases leave the stack with a temperature of about 750 deg. F., and can be cooled down to about 350 deg. F., thus giving 95 B.t.u. per lb., corresponding to about 1 lb. of feedwater. If the condensate leaves the condenser at a temperature of 122 deg. F., it will therefore be possible to heat the feedwater to 217 deg. F. The total heat of the steam in the boiler being 1,350 B.t.u., the saving effected by heating the feedwater thus amounts to 7.5 per cent.

There are other possibilities of heating the feedwater with steam, which latter can be exhaust steam from auxiliary turbines or steam bled from the main or an auxiliary turbine. Steam being exhausted at atmospheric pressure from a back-pressure turbine, as in the case of the turbine driving the furnace fan of the experimental turbine, has a total heat of about 1,150 B.t.u. Were this steam used in a low pressure turbine working to the condenser, probably 72 B.t.u. could be transferred to useful work, but the steam would enter into the condenser with 1,080 B.t.u. of which 990 B.t.u. would go to the cooling water and thus be lost. Using the exhaust steam in the heater, all the 1,150 B.t.u. can be utilized. Under normal steam conditions the feedwater can be heated up to about 302 deg. F. The condensate having a temperature of 122 deg. F., we can, therefore, use 180 B.t.u. per lb. of feedwater. The maximum quantity of exhaust steam which can be utilized is accordingly one-fifth of the quantity of condensate. To heat up to this high pressure, of course, steam at a pressure higher than that of the atmosphere has to be used.

The greatest locomotive economy would be effected by preheating the combustion air with smoke gases and the feedwater with steam in a series of feedwater heaters, all heated by steam of different pressures bled from the main turbine or by exhaust steam at a suitable pressure. Steam bled from the main turbine or steam from the furnace-fan turbine will always be the most convenient, as the proportion of steam to feedwater is adjusted automatically.

Steam and Coal Consumption—The steam consumption of a turbine working condensing is very much less than that of a reciprocating engine working non-condensing. The condensing machines, however, require a number of auxiliaries also consuming steam and thus lowering the overall efficiency to a certain extent. In calculating the coal consumption, it is necessary to consider carefully what preheating system shall be employed as the coal consumption depends to a very great extent upon this factor.

Economies Shown by Tests

Tests have been conducted with this experimental locomotive, but only over a line of 35 miles which had variable grades. This made it impossible to make coal-consumption tests. All that could be determined was the steam consumption, which may be compared with that of a corresponding reciprocating locomotive making the same journey with the same load. Preheating was employed on the turbo-locomotive and only saturated steam was used for the auxiliaries. The consumption of heat in the turbo-locomotive for the round trip was only 4,230,000 B.t.u. An ordinary locomotive with the same train and identical operating conditions, will consume 5,904,000 B.t.u., calculated from the difference in water levels in the tender before and after the run and the initial steam conditions. These tests were repeated four times and the averages are given in Table I. The water consumption of the recooler was approximately 1,400 gals. Quite a large amount of this water represented mechanical losses through leakage.

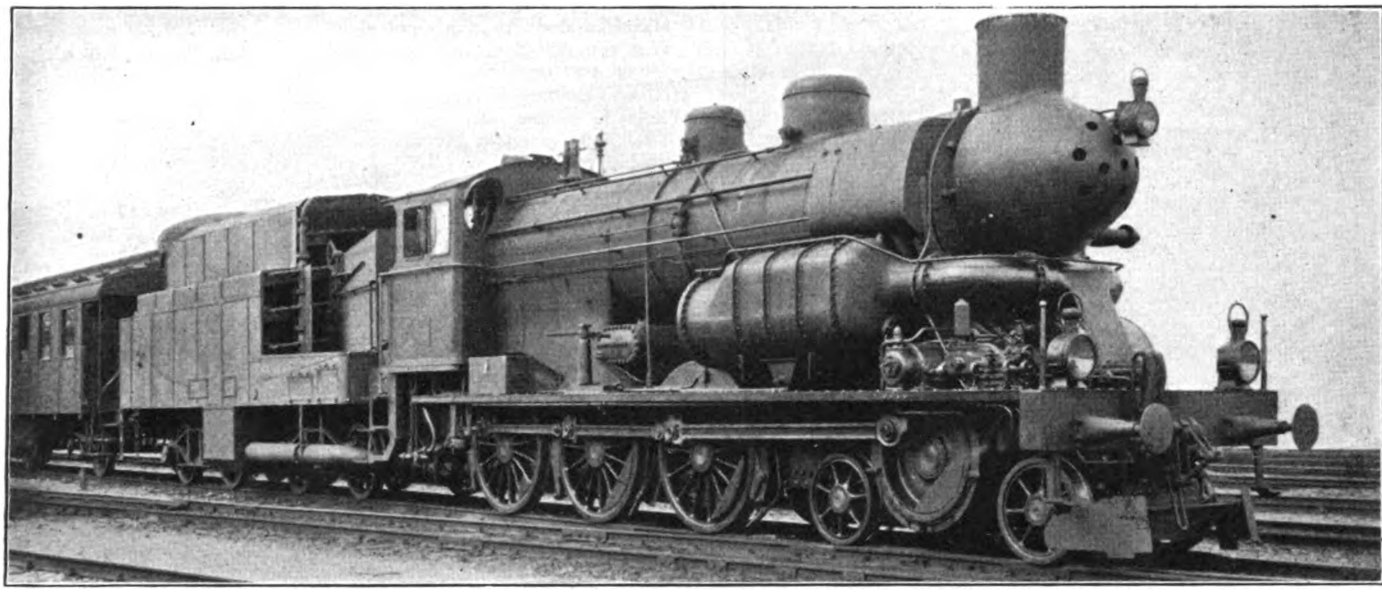
Operation and Maintenance is Comparatively Simple

In spite of the numerous parts comprising a turbo-locomotive, its operation is simple and less attention is required on the part of the personnel than is the case with the ordinary reciprocating locomotive. Before starting the locomotive the engineer speeds up the turbine driving the fan on the recooler.

This turbine is connected in series with the turbine driving the condensing auxiliaries and the condensing plant is started automatically. After the proper working vacuum has been attained, which requires several minutes, the steam-admission valve to the main turbine is opened wide and then it is only necessary to open or close the governor valve in order to start or stop the train. The exhaust fan should also be started as soon as the engineman starts to work the locomotive. The opening of this valve is governed in such a way that the boiler pressure is kept constant. Boiler feeding requires no attention from the engine crew, except to see that the pump is working properly. All that is required to keep the locomotive going at a certain speed is simply to throttle the steam admission to the required extent. If for any reason the output is insufficient when the governor valve is wide open, then the overload valve will allow an increase. The auxiliaries should not be shut down unless for a prolonged stop.

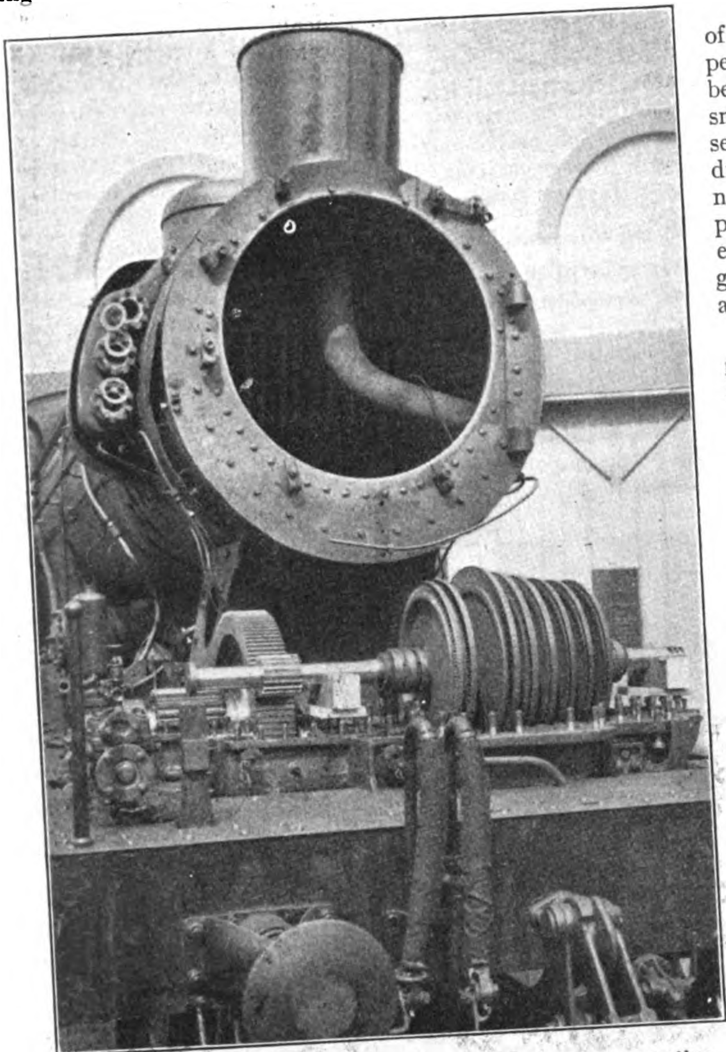
In order to run the locomotive backwards the valve for running ahead is closed and that for running astern is opened. The engineman then operates the governing valve as before.

The locomotive makes a smooth start which seems to contradict the opinion expressed by many engineers that a turbine-driven locomotive would not have sufficient initial



Standard 2-6-0 Reciprocating Type Converted into a Turbine-Driven Condensing Locomotive by Escher Wyss & Co., and the Swiss Locomotive Works

torque to start a train. The running of the turbine-driven locomotive is smooth when compared with that of a reciprocating locomotive. Dynamometer tests taken on the Swiss Fed-



The Rotor and First Reduction Gear of the Zoelly Locomotive

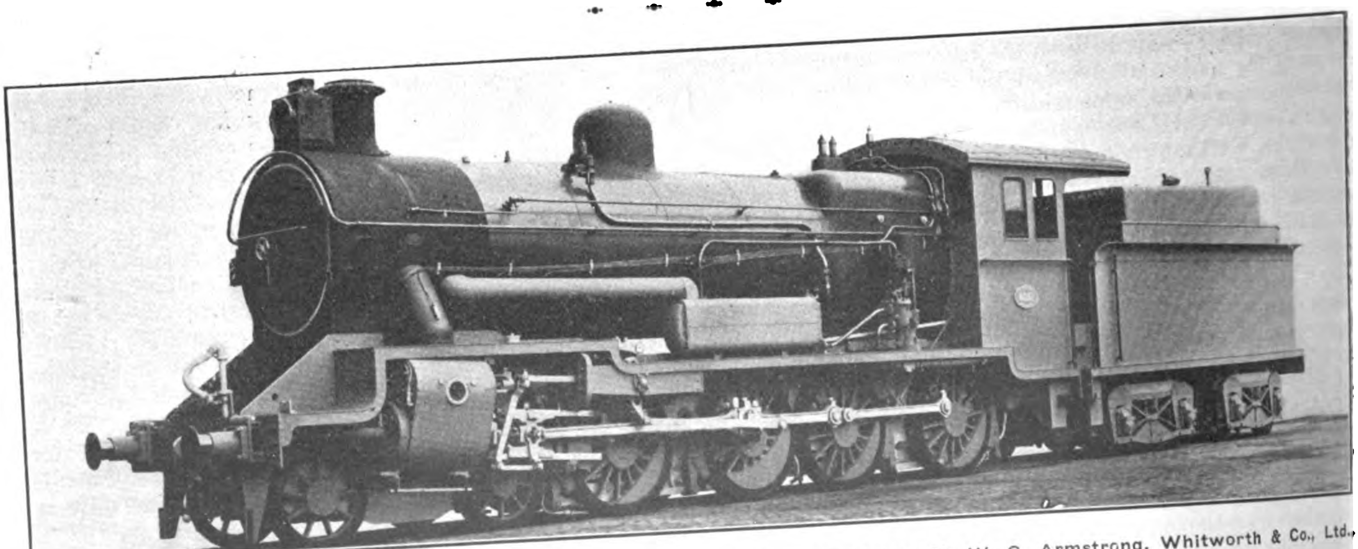
eral Railways showed that the pull at the drawbar was free from fluctuations.

A further development of the turbine-driven locomotive is at present impending which involves the employment of very high pressures. The practical utilization, however, depends upon the finding of a suitable boiler. As far as the turbine itself is concerned, the designs are ready.

The advantages of the turbo-locomotive are many. Some of them are, high economy in fuel, amounting to nearly 50 per cent; low water consumption and the water not necessarily being good boiler water; the boiler can be kept clean, and smooth running conditions obtained on account of the absence of reciprocating parts. It is predicted that the turbine-driven locomotive will soon enter into successful competition not only with the reciprocating locomotive but also with plans for electrification which are expected to result in greater efficiency in the utilization of coal. Its greater economy gives increased capacity with the same boiler and thus opens a new era of steam-locomotive traction.

Table of Dimensions, Weights and Proportions

Railroad	Swiss Federal Railways
Builders	Escher Wyss & Co., Zurich, Switzerland. Swiss Locomotive Works, Winterthur, Switzerland.
Service	Experimental
Turbine	6-Stage impulse Zoelly
Maximum speed, running ahead	7,500 r.p.m.
First gear reduction	1 to 7
Second gear reduction	1 to 4.1
Maximum speed	47 m.p.h.
Weights in working order:	
Total engine	130,000 lb.
On drivers	91,200 lb.
Wheel bases:	
Driving	12.3 ft.
Total engine	25 ft.
Total engine and tender	58.4 ft.
Wheels, diameter outside tires:	
Driving	60 in.
Front truck	33 in.
Boiler:	
Type	Conical
Steam pressure	200 lb. per sq. in.
Superheat	662 deg. F.
Fuel, kind	Bituminous
Grate area	25 sq. ft.
Heating surfaces:	
Firebox and combustion chamber	132.5 sq. ft.
Tubes and flues	927.5 sq. ft.
Total evaporative	1,060 sq. ft.
Superheating	380 sq. ft.
Comb. evaporative and superheating	1,450 sq. ft.
General data estimated:	
Turbine horsepower	1,000 hp.



12-Wheeled Locomotive Built for the Buenos Aires Great Southern Railway by Messrs Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, England, Which Was Exhibited at the British Empire Exhibition

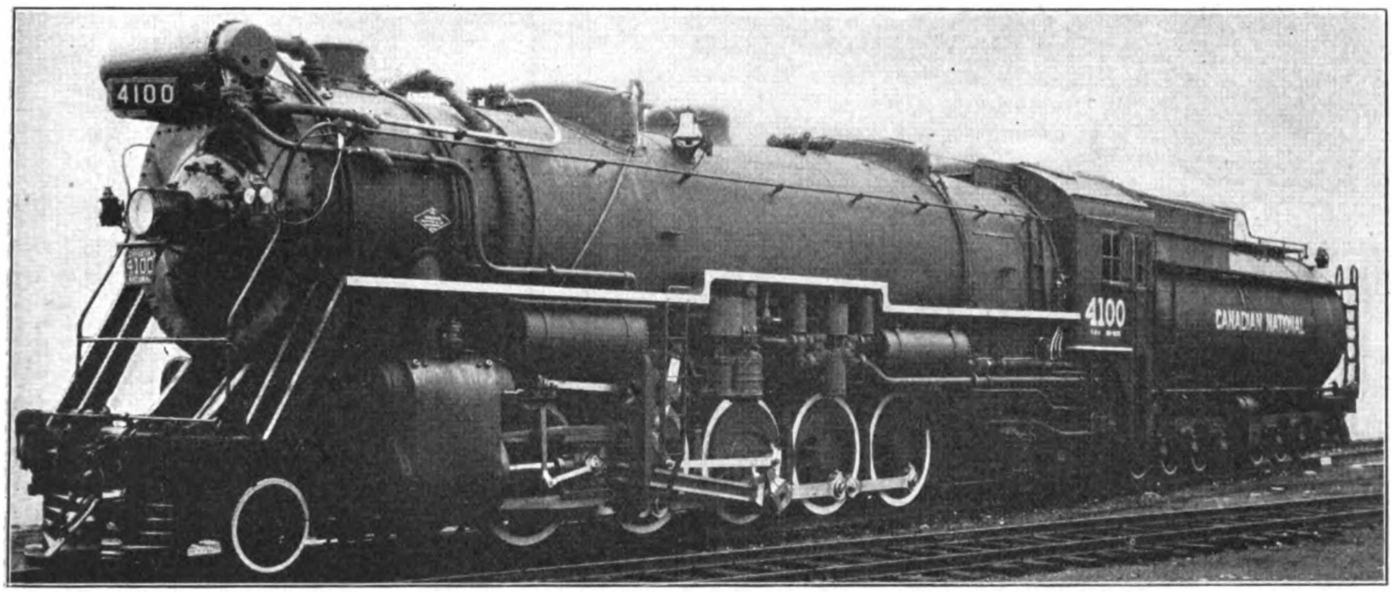
New Santa Fe Locomotives for the C. N.

Largest of Their Type in the World—Develop a Maximum Tractive Force of 91,735 pounds

By C. E. Brooks
Chief of Motive Power, Canadian National

THE Canadian Locomotive Company, Kingston, Ont., has recently delivered five Santa Fe type locomotives to the Canadian National. These locomotives are the largest in the British Empire and are also considered to be the largest of their type in the world. They were built for heavy transfer service between the Danforth and Mimico yards in the Toronto, Ont., terminal district, a distance of 12 miles with a maximum grade of 0.6 per cent going west and 1.2 per cent going east.

These locomotives are known on the Canadian National as the T-2-a class, road numbers 4100 to 4104. They have a total weight, without the tender, of 409,000 lb. The weight on the drivers is 321,000 lb. The tractive force, without the booster, is 80,200 lb., and 91,735 lb. with the booster. The cylinders are 29 in. by 32 in., and the driving wheels are 57 in. in diameter, with 50-in. cast centers.



Santa Fe Type Locomotive Built for the Canadian National by the Canadian Locomotive Works, Kingston, Ont.

The Boiler, Firebox and Attachments

The boiler is of the extended wagon top type with radial stays, conical bottom, and has a combustion chamber. The largest course is 104 in. in diameter. The boiler horsepower is 106.7 per cent of the cylinder horsepower on the basis of Cole's ratios. The flues are welded into the back tube sheet and the Canadian National's standard method of crown staying, similar to that used on the Mountain type locomotives, described in the August, 1923, issue of the *Railway Mechanical Engineer*, was carried out.

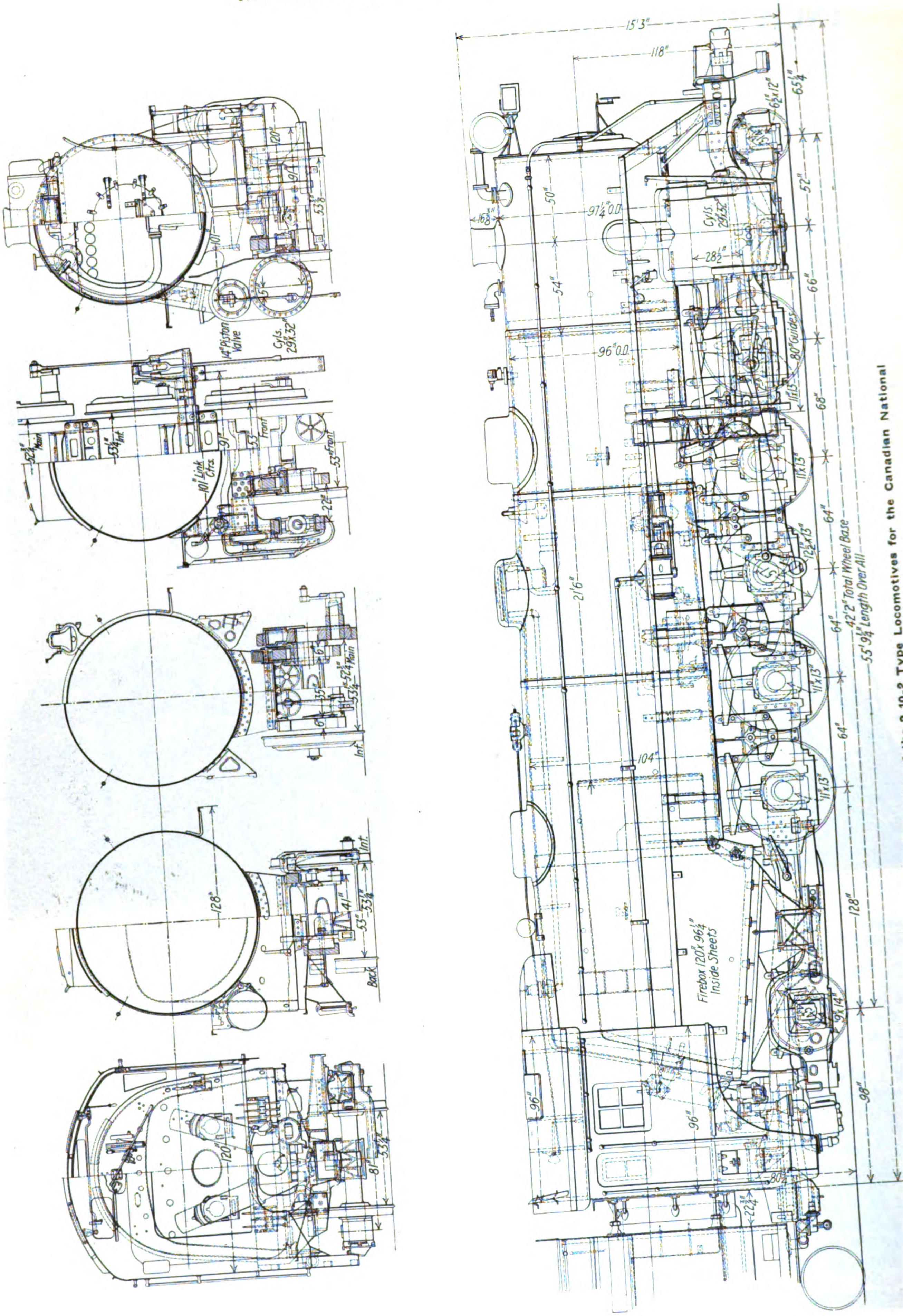
The locomotives are equipped with Duplex stokers and Elesco type feed water heaters, the drums of which are mounted on brackets on the front of the smokebox. Hancock non-lifting inspirators with 6,000 gallon tubes are located on the right-hand side.

The boilers are equipped with Type A superheaters and Franklin No. 9 fire doors. Steam for the boosters, with which the locomotives are equipped, is taken directly from the superheater header and the main shut-off valve is placed behind the stack.

The grates are of the Canadian National standard design, the rocking grate bars being of alloy cast steel with detachable lugs. The ashpans are of the center hopper type with an auxiliary hopper placed on each side of the engine outside of the trailing truck frame. These auxiliary hoppers are equipped with cast steel frames and doors and are designed principally to improve what would otherwise be a comparatively flat pan owing to the use of a Delta truck and booster. The Canadian National's standard sludge arrangement, consisting of a 1¼-in. pipe from the delivery pipe of the inspirator to the ashpan, with a valve which is operated from the cab and a branch extending into each hopper, is also applied. This arrangement has been found to be very serviceable during the severe winter weather encountered in Canada. In addition, an auxiliary ashpan blower is used, consisting of a ¾-in. perforated pipe across the back of the ashpan, which obtains its steam supply from the turret. This device is found desirable because the booster application and wide firebox somewhat restricted the slope of the pan at the back.

The Frame and Running Gear

The frames, with a single forward section, are made of vanadium steel, the rear end being fitted with a Commonwealth cast steel cradle casting. The wheels are fitted with brass hub liners. Hollow driving axles are used, the main journals being 12½ in. by 13 in. and the others 11 in. by 13 in. Grisco driving boxes have been applied at the main wheels, the feature of this box being a three-piece crown bearing fitted with a wedge adjustment. Lateral motion boxes have been applied at the front driving wheels and Franklin spreaders are applied to all boxes with the exception of the main drivers which are equipped with a cellar of



Elevations and Section of the 2-10-2 Type Locomotives for the Canadian National

special design. The crossheads are fitted with Rogatchoff adjustable wedges. The main rods and also the front and back intermediate rods are made of carbon vanadium steel. The back ends of the main rods are of the solid type and have floating bushings.

The engine truck is of the Economy two-wheel constant resistance type equipped with Preston hub slip liners. The wheels are 31¼ in. in diameter with spoked steel centers 25 in. in diameter. This type of wheels is common to all Canadian National freight locomotives of modern design. The journals are 6½ in. by 12 in. The trailing truck is of the Commonwealth constant resistant type, adapted to carry a booster with 43-in. wheels, 35-in. cast steel centers, and 9-in. by 14-in. journals.

Steam distribution is provided for by a Walschaert valve gear, the diameter of the piston valve being 14 in. The valves are set with a travel of 7 in., 1-3/16-in. lap, ⅛-in. lead, and line and line. A Precision power reverse gear is applied. The cab is of the Canadian National's short vestibule type of substantial construction securely riveted to the boiler with 3-in. by 4-in. angle iron around the front. In order to take care of expansion the cab brackets are designed to permit the cab to slide on the cradle casting. The railway company's standard turret, which was also described in the article on the Mountain type locomotives, to which reference has already been made, as well as the Hancock non-lifting inspirator operating valve, the blower valve and the stoker engine valve are placed outside the cab.

The sand boxes are fitted with Hanlon sanders. Three 3½-in. World type safety valves are used, one of which is muffled. The air brake equipment is of Westinghouse manufacture, in which is included one 8½-in. cross-compound pump. The headlight equipment consists of a Pyle-National turbo generator set and Keystone lamp case on both the front of the engine and at the rear of the tender, which are fitted with 14-in. Golden Glow reflectors. The Canadian National's standard separate number lamp is used on the front of the engine. The water level indicating device consists of the railway company's standard water column welded directly to the backhead to which are fitted the try cocks and water glass fittings. The water glass is fitted with the railway's closed type of protector. Steam is passed into the train heating lines through a World-Leslie reducing valve. The piston and valve rod packing is King metallic. The radial buffer and unit safety bar are used between the engine and tender, and the piping between the engine and tender is equipped with Barco joints. A Madison-Kipp four-feed mechanical lubricator is used for lubricating the valves and cylinders and a Nathan three-feed lubricator is used for the auxiliaries.

Table of Dimensions, Weights and Proportions

Railroad	Canadian National
Builder	Canadian Locomotive Company
Type of locomotive	2-10-2
Service	Freight
Cylinders, diameter and stroke	29 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	Piston, 14 in.
Weights in working order:	
On drivers	321,780 lb.
On front truck	28,780 lb.
On trailing truck	58,680 lb.
Total engine	409,240 lb.
Tender	245,800 lb.
Wheel bases:	
Driving	21 ft. 8 in.
Total engine	42 ft. 2 in.
Total, engine and tender	80 ft. 9¾ in.
Wheels, diameter outside tires:	
Driving	57 in.
Front truck	31¼ in.
Trailing truck	43 in.
Boiler:	
Type	Ext. wagon top
Steam pressure	200 lb. per sq. in.
Fuel, kind	Bituminous
Diameter, first ring, inside	94½ in.
Firebox, length and width	120 in. by 96¼ in.
Combustion chamber, length	45½ in.
Tubes, number and diameter	264—2¼ in.
Flues, number and diameter	50—5½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	80.3 sq. ft.
Heating surfaces:	
Firebox and arch tubes	356 sq. ft.
Tubes and flues	5,178 sq. ft.
Total evaporative	5,534 sq. ft.
Superheating	1,558 sq. ft.
Comb. evaporative and superheating	7,092 sq. ft.
Tender:	
Water capacity	11,000 Imp. gallons
Coal capacity	16 tons
General data estimated:	
Rated tractive force, 85 per cent	80,200 lb.
Rated tractive force with booster	3,025
Cylinder horsepower (Cole)	3,200
Boiler horsepower (Cole) (est.)	91,735 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	78.5
Weight on drivers ÷ tractive force	4.01
Total weight engine ÷ cylinder hp	135
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp	2.34
Tractive force ÷ comb. heat. surface	11.32
Tractive force × dia. drivers ÷ comb. heat. surface	644
Cylinder hp. ÷ grate area	37.65

Tender Design

The tank is of the Vanderbilt type and is the first of its kind to be used in Canada. The water capacity is 11,000 Imperial gallons and the coal capacity is 16 tons. The tank is carried on a Commonwealth cast steel tender frame and six-wheel tender trucks with 34¼-in. steel tired wheels and semi-steel center 28 in. in diameter and 5½-in. by 10-in. journals. The trucks are equipped with clasp brakes.

This locomotive has maintained in actual service a drawbar pull of 77,000 lb. to 79,000 lb. on a one per cent grade. The important proportions and dimensions are in the table.

Setting Valves Without Plus or Minus Signs

By L. R. Linn

Supervisor of Apprentices, Duluth, Missabe & Northern, Proctor, Minn.

A majority of valve setters would probably prefer using methods for figuring valve changes that do not involve the use of the plus and minus signs, especially if changes have to be made in the formulas for various designs of gear.

To a great many persons who study valve setting, the divisor four seems to be an arbitrary figure, the derivation of which they cannot comprehend. The formula in the article by H. W. Stowell, on page 596 of the October issue of the *Railway Mechanical Engineer,* gives the derivation of this figure but to make it comprehensive to the machinist or apprentice it seems to me that the formula should be shown solved step by step. Taking the equation $a - b = c - d$ to determine the necessary change of the valve, effected by a change of the eccentric rod, letting x equal the change of the valve and solving step by step, we have:

$$a-b=c-d$$
$$(a+x)-(b-x)=(c-x)-(d+x)$$

Removing parentheses, and collecting like terms by transposing:

$$4x=b+c-a-d$$
$$x=\frac{(b+c)-(a+d)}{4}$$

This result must of course be multiplied by the ratio, as explained in the recent article referred to, to ascertain the necessary amount of change in the eccentric rod.

Let us now take the equation for figuring the valve stem

change, letting x equal the required change and solving step by step:

$$a-b=d-c$$
$$(a+x)-(b-x)=(d-x)-(c+x)$$

Collecting like terms, combining and re-arranging:

$$4x=b+d-a-c$$
$$x=\frac{(b+d)-(a+c)}{4}$$

An arbitrary rule is one that holds good for one condition and must be revised for another condition and such is the case in determining the direction of the change of the eccentric rod by the plus and minus signs.

It may be assumed that any person setting valves or interested in valves, knows when a motion is direct or when it is indirect, and that a change in the length of the eccentric rod will move the foot of the link, or the gear connecting rod, depending on the type of valve gear used, forward or back, agreeing with the change made on the eccentric rod.

Let it first be determined, by examination of the figures, whether the foot of the link should be brought forward or back to give the desired change on the valve. With this determined, the change of the eccentric rod is obvious. The foot of the link would be moved in the same direction as the valve with direct motion and in the opposite direction as the valve with indirect motion. With this in mind let us now consider another method of figuring eccentric rod changes that may be followed for any arrangement of valve gear and that does not bring into use the plus and minus signs but merely calls for the exercise of a little reasoning ability.

Adopting the conventional form for representing the condition of the valve gear and letting the arrow indicate the front of the engine, we have:

a | | b forward motion
——————→
c | | d back motion

With an eccentric rod change on a valve gear direct in one motion and indirect in the opposite motion it is evident that like changes will result at opposite ends of the valve for the forward and backward motion; that is, if a is to be increased, d will be increased an equal amount and b and c will be decreased by the same amount. Adding the two sets of figures that have like changes, then subtracting the lesser sum from the greater and dividing by four, will give the value of x in the formula.

Let us illustrate by a definite case. Suppose the following condition exists:

1/4 | | 3/8 forward motion
——————→
5/8 | | 0 back motion

$1/4+0=1/4$
$5/8+3/8=8/8$

Subtracting the lesser from the greater we have:

$8/8-1/4=6/8$

Dividing by 4, we have:

$x=6/8\div 4=6/32$ or $3/16$

The amount to change the eccentric rod is 3/16 times the ratio for this particular gear.

A Method to Determine Whether to Lengthen or Shorten the Eccentric Rod

Observe whether the back-up or forward motion has the greatest difference, thus:

$3/8-1/4=1/8$ difference in forward motion.
$5/8-0=5/8$ difference in backup motion.

Change the eccentric rod to favor the motion with the greatest difference, in this case the back-up motion, and the valve should be moved back, always toward the greatest figure, which would call for the foot of the link to come ahead if the back-up motion is indirect, or come back if the back-up motion is direct. With a valve rod change it is evident that like changes will result at the front ports of both motions and like changes will result at the back ports of both motions, but opposite to the changes at the front ports; that is, if b and d are increased, a and c will be decreased or vice versa. Adding the figures at b and d and also those at a and c, and then subtracting the lesser from the greater and dividing by four will give the value of x in the formula for the valve stem.

Using as an illustration the assumed definite case, we have:

$3/8+0=3/8$
$1/4+5/8=7/8$

Subtracting the lesser from the greater, we have:

$7/8-3/8=4/8$

Dividing by 4 we have:

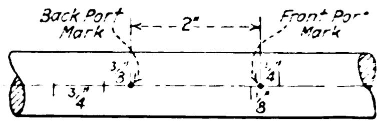
$x=1/8$

No ratio is used here as the valve is moved 1 to 1 with the change of the valve stem.

To determine whether to lengthen or shorten the valve stem add the two front figures, b and d, also the two back figures a and c, and make the change to move the valve toward the greater sum, thus:

$3/8+0=3/8$
$1/4+5/8=7/8$

The back figures would give the greater sum which indicates that the valve must be moved back, as the object of valve setting is to have equal figures at the four points. Thus it will be seen that the valve rod must be shortened.



The Position of Each Valve Event Scribed on the Valve Stem

To eliminate a minus sign when the tram falls between the two port marks as shown in the illustration, we may measure from the tram marks to the farthest port mark, obtaining the following measurements:

2 3/8 | | 2 1/4
——————→
2 3/4 | | 1 7/8

Figuring x for the eccentric rod change:

$2\,3/8+1\,7/8=4\,1/4$
$2\,1/4+2\,3/4=5$

Subtracting the lesser from the greater:

$5-4\,1/4=3/4$

Dividing by 4 gives us:

$x=3/4\times 1/4=3/16$

Figuring x for the valve rod change:

$2\,1/4+1\,7/8=4\,1/8$
$2\,3/8+2\,3/4=5\,1/8$

Subtracting the lesser from the greater:

$5\,1/8-4\,1/8=1$

Dividing by 4 gives us:

$x=1/4$

The eccentric rod will be changed to favor the backup motion as the greatest difference exists in this motion. The valve rod will be shortened so as to pull the valve back, as the greatest sum is at the back end:

Proving the Results

After changing the eccentric rod the figures will be as follows:

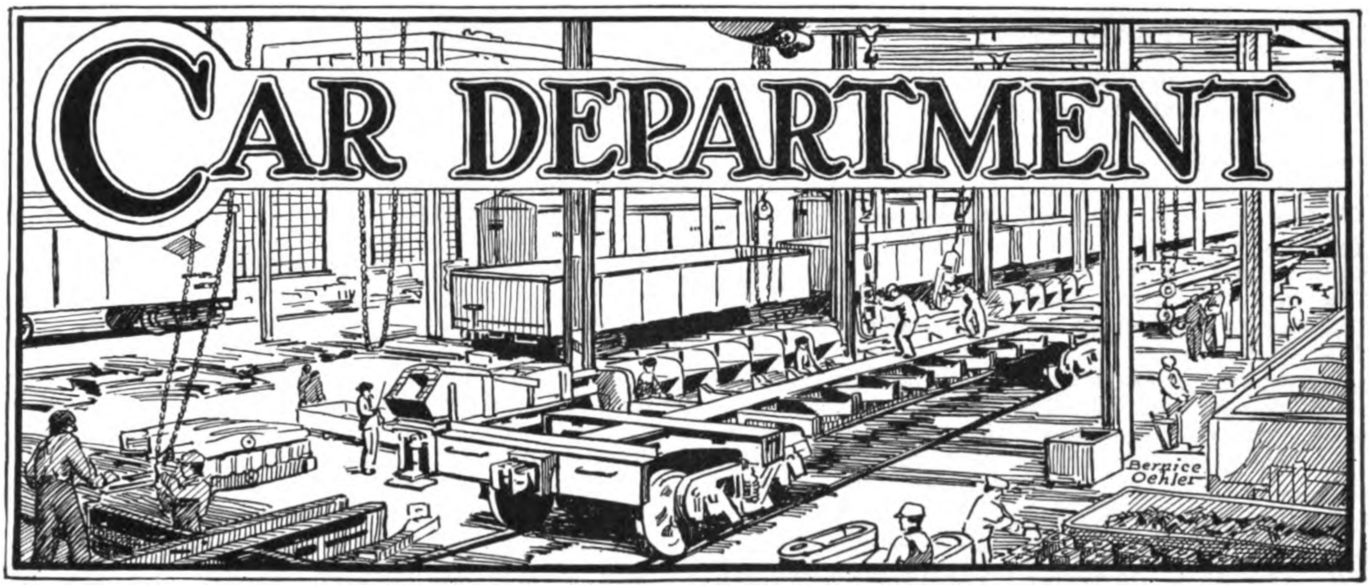
2 9/16 | | 2 1/16
——————→
2 9/16 | | 2 1/16

After changing the valve rod the figures will be as follows:

2 5/16 | | 2 5/16
——————→
2 5/16 | | 2 5/16

The two inch measurement between the port marks may now be subtracted from each figure if desired, which would give:

5/16 | | 5/16
——————→
5/16 | | 5/16



Discussion of New Car Interchange Rules

Extensive Debate on Application of Rule 32—Question Raised as to Proper Credit for Scrap Wheels

At the twenty-third annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held at the Hotel Sherman, Chicago, September 23, 24, and 25, the new rules of interchange were discussed at length. Below will be found an abstract of the discussions relating to the changes to become effective in the new rules.

Rule 2

T. S. Cheadle (R. F. & P.): I would like to ask a question on paragraph 6 of Rule 2. That is in connection with 25 per cent of roof boards. Does that mean a wooden roof or does it mean a metal roof?

J. J. Gainey (Southern): The rule is plain on that. It says roof boards.

I was at a terminal not long ago where the car foremen were in dispute, also the chief interchange inspector, claiming that an arch bar was passed just the same as a metal truck side in interchange. I would like to know what the members of this association think about it.

A. F. Owen (L. & N.): In what way was it cast, the same as a cast steel truck side?

Mr. Gainey: If it was a broken arch bar they claimed they could reject the car or transfer it just the same as they could for a metal truck side.

Mr. Owen: The way I understand the rule they cannot. A cast steel truck side delivered to an owning line if transferred is an owner's responsibility. If delivered to a foreign line it is a delivering line responsibility. Whereas an arch bar is supposed to be repaired by the receiving line while the car is under the load.

A. Armstrong (Southern): Section 3 is very plain, "all other defects on foreign cars except." Arch bars are not mentioned.

Mr. Cheadle: The same question was raised in my territory, and answered in accordance with the interpretation on page 13 of the Rules. The receiving line has the right to refuse any car which it judges unsafe for movement on the line. The receiving line has a right to reject under that rule.

A. Herbster (N. Y. C.): This has reference to loaded cars interchanged only, I presume, as I do not believe anybody would be taking an empty car with a broken arch bar. There are arch bars of peculiar construction. Some are pressed steel and others channel arch bars. It may enter into a case of wrong repairs with some road and perhaps that is why they are refusing the cars.

M. E. Fitzgerald (C. & E. I.): The Committee on Car Construction have designed an A. R. A. standard arch bar and the rule plainly indicates that if the car is delivered to you with a broken arch bar it is up to you to repair it. You will not make wrong repairs if you apply the A. R. A. standard to that car.

T. J. O'Donnell: May I refer to Rule 2 on inside door protection? What do we do with the small end doors? What do you do with the automobile double doors? How are you going to keep your load in?

W. R. Rogers (Youngstown, O.): It is very evident that the railroad making the adjustment and applying the door protection is to be paid for the work regardless of whether or not the guilty road is penalized. On the face of the interpretation it appears that the road that can best afford to pay for it, that is, the road earning the revenue or in other words, the *road haul road* pays the bill notwithstanding the fact that they are not the road originating the load, in other words, "Not Guilty But Pay the Costs." The intent of the rule was to penalize the originating road for their failure for not compelling the shipper to comply with the loading rules, but the interpretation, to some extent at least, defeats the intent and purpose of the rule, as in many cases the trunk line originating the load acts as a switching road either on an actual cost basis or a reciprocal cost, and in such cases the road haul road has no redress, that is, the shipment not originating on their line they cannot themselves compel the shipper to use door protection. The road haul road is told that they can make settlement with the

switching line by special arrangement, in other words, "Try and Get it."

Had the answer to question 4 read, "Bills should be made against the road haul line using the original billing, the road haul line to make counter-bill against switching line unless special arrangements are made to the contrary," it would, in my opinion, place the responsibility where it rightly belongs.

The first paragraph of Loading Rule 34 makes it compulsory to secure lading (brace and block it) so that it will not come in contact with side doors or roll or shift in transit.

The second paragraph of that rule provides that lading of a "Character" requiring protection to prevent it falling or rolling (it does not say "shifting") out at door way or coming in contact with door while in transit must have the prescribed stripping across the door opening. In other words if the lading is of a character that it is not practicable to brace and block it, and it is liable to fall or roll against door, then the door ways are to be stripped as provided in the third paragraph of that rule.

The last paragraph of Rule 34 requires that lading loaded in vehicle cars with end doors must be securely protected against end shifting and loaded in such a manner that lading will not come in contact with end doors. In other words, it is the lading that is to be protected against end shifting, brace and block it or load it in such a manner as to prevent shifting. The rule does not make any attempt to provide end door protection as it does for side doors. The protection as provided for side doors would be useless if used to prevent lading from longitudinal shifting against end doors.

Where the loading rules specifically cover, as in the case of tires, wheels, barrels, etc., or brick when not loaded in the specified manner, if the lading has not shifted or come in contact with the doors, and door protection is omitted, it is my opinion that the protection can be applied at the expense of the originating road.

In cases where the loading rules do not specifically cover, I believe that the lading would have to require adjustment before a bill would be justified, for the reason that the originating road is always responsible regardless of whether discovered at an interchange point or on the road. In other words, the intermediate road is protected if necessary to adjust load. I would consider it sharp practice to permit inspectors to open up the side doors unless there was a very good reason for it (doors showing stress of load against it).

Mr. O'Donnell: If you put a load of lumber in one of those cars, and the shipper fails to brace and block it, who is going to pay for it?

Mr. Rogers: With me the original road is responsible for it, but you have got to brace and block that kind of a door. Make the delivering line responsible for the shifting of the load.

Mr. O'Donnell: I won't do it. We are delivering about thirty or forty cars a month, I should say, and they are accepting all of ours. We will take that as settled.

Mr. Cheadle: Before you get off this question of door protection, I want to say this: On our line it has given us a tremendous amount of trouble, in connection with the collection of bills. We, of course, have the rule of the Committee, but I understand that in over 50 per cent of the cases where bills have been rendered, questions have been raised.

Our road has also received from one road a circular saying that they would not pay or accept charges for such work. We do not charge for door protection except where the door is under distress, and only where we apply the door protection from the inside. If it is applied from the outer side, it is classed as temporary repairs and no charge is made except for the handling line. We do not charge for shifted lumber. If a car with an end door is to be loaded with a commodity that would roll and fall, we do apply for door protection whether they are large or small end doors. Of course, the majority of railroads, I presume, handle those bills entirely through their traffic department, but with my line, the work of adjustment is done entirely by the mechanical department. Therefore, that is why, I presume, I am the only one here who knows we are having trouble in this particular manner.

Mr. O'Donnell: When you have just labor, applying no material, do you charge for it?

Mr. Cheadle: No, we do not.

Mr. O'Donnell: I think the late rules tell us that lumber, I think it is less than eight or ten feet, will get to the end door which becomes in distress. We can charge the originating line for such lumber. If it is long lumber, the whole length of the car, we can not charge for it.

I am going to answer Mr. Cheadle on the question of refusing bills. Mr. Hawthorne tells me that our arbitration committee is working on that, and I believe in the near future they will make it mandatory.

I recommended in my talk that instead of these bills being handled through the auditor, superintendent and general manager, they should be referred to a car man, either a general car foreman or master car builder, and his knowledge of the shifting of load in box cars will indicate to him right away whether the bill should be accepted. Now, the operating department is shooting them back and forth without any instructions.

Secretary Sternberg: I will say for Mr. O'Donnell's information that on our road all of those bills are handled through our office and that of the superintendent.

Mr. Lynch: It is generally understood, according to the rule, that the road originating the load is responsible for the proper loading of the car. There is an interpretation to the rule concerning the road on which the shipment originates and where it is given to another carrier, and that rule complicates the matter a good deal.

I want to give you an example, using the numerals 1, 2, and 3 instead of the names of the roads. Road 1 loaded a car at East St. Louis. It was handed over to Road 2 which hauled it to Cairo, Illinois, where it was handed over to Road 3. The latter hauled the car into Cleveland and delivered it to Road 4. The doors were found in distress and the necessary note was attached and the work done. Now, in that case, both roads had a road haul on the shipment. Which road is responsible, Number 2 or Number 1? This is simply an example of what the interpretation means in regard to relieving the road originating the load from responsibility, in case it is acting as agent for the carrier.

Mr. Schultz: That very thing brings about the refusal of a great many of these bills. A road waybills the load out. As the shipment proceeds it goes on the original bill to destination, and the information we have to furnish is what we get from the waybill. If a switching line has an organization which bills out the freight loaded on their line, naturally the bill goes against them, and practically all the trouble you have in collecting these bills is because of lack of information. They never knew they had the load, in some cases. In other words, they say they never loaded the car. A load will be loaded on the Coast, for example, go about half way across the continent and the man who rebills it does not show the originating road. The information shows that the intermediate line loaded the car when, in fact, it was handled by two previous lines. I question whether our method of collection in this manner is going to be a success.

Mr. O'Donnell: We have a ruling, Mr. Chairman, that the road furnishing the bill is responsible for the door protection. In our district we have a switching road. They furnish no bill. The bill simply goes to the carrying line. Now, if two trunk lines are interested, we will say the Erie and the Nickel Plate, and a car of fertilizer is loaded on the Erie. The Erie has nothing to do with the car, so far as doorway protection is concerned, under this rule. The

Nickel Plate furnishes the door protection and takes care of the labor.

Mr. Rogers: In the city of Youngstown, we have four large trunk lines acting as switching agents for each other. Just as Mr. Lynch says, the Pennsylvania may originate the load, the Erie may get the haul, and consequently in this case the Erie may have the door protection. They have no redress. They cannot go to the shipper and say, "Put in your door protection." The result is this, they are penalizing the wrong road.

Mr. O'Donnell: I agree with Mr. Rogers logically. It has always been our custom heretofore, before this rule on door protection was adopted, to charge the loading line. The powers that be have ruled, however, that the person furnishing the bill is responsible for the lading, so far as that part of it is concerned.

The Committee recommends that the effective date of the second paragraph of Section (b) be extended to January 1, 1926, the paragraph to be modified in accordance with proposed form shown below.

PROPOSED FORM—After *January* 1, 1926, cars equipped with couplers having riveted yoke without lugs, *where such yokes are riveted directly to the coupler,* will not be accepted in interchange.

Section (e) tank cars, the safety valves *or tanks* of which are due for test within 30 days, will not be received from owners.

Tank cars (empty or loaded), will not be accepted in interchange unless they comply with the A. R. A. Tank Car Specifications, *with the following exceptions:*

Loaded tank cars tendered for shipment must be inspected by the carrier before acceptance, to see that they are not leaking; that the air and hand brakes, journal boxes, trucks and safety appliances are in proper condition for service; and that the *car* has been tested within limits prescribed by American Railway Association specifications for tank cars. Safety valves on tank cars must not be tested while these cars are *loaded.* Whenever *the test of safety valve or tank* is due on the loaded car *while* in transit, *unless the car is leaking or in a manifestly insecure condition, it must be forwarded* to destination carded on both sides as follows:

(1) When loaded with dangerous articles—
Safety Valves / *Tank* } overdue for test.
Moving under I. C. C. 402.

Prompt report of such movements, showing initials and number of car, must be made by railroads carding the cars to the Chief Inspector, Bureau of Explosives, 30 Vesey Street, New York City.

(2) When loaded with non-dangerous articles
Safety Valves / *Tank* } overdue for test.
Moving under A. R. A. Interchange Rule 3, Section (e).

(3) *Empty tank cars when consigned to owner or lessee for test of tank.*
Safety Valves / *Tank* } overdue for test.
Moving under A. R. A. Interchange Rule 3, Section (e).

Mr. Trapnell (C. I. I., Kansas City, Mo.): Of course that is quite a concession to give them, and while it tells you that you cannot receive the car from the ower it makes provision whereby you can move it.

Mr. O'Donnell: Do you move it away from the owner's line, the owner's plant?

Mr. Trapnell: I could not say that because I do not intend to be incriminated, but they get on the line somewhere.

Mr. O'Donnell: I think that we ought to be consistent in this. Either loaded or empty cars from the owner should not be accepted. That is the trouble. They get down in our district and we are up against it. There ought to be more observance of the rule at the owner's gateway. We absolutely refuse to take them from the owner, loaded or empty.

The Committee recommends that the effective date of Section (i) be extended to January 1, 1926, and that the section be modified as follows:

(i) After *January* 1, 1926, cars will not be accepted from owner unless equipped either with *steel underframe,* wooden or metal draft arms extending beyond the body bolster, or metal draft arms extending to metal body bolster and securely riveted to same.

The Committee recommends that the effective date of the second sentence of Section (l) be extended to January 1, 1926, as follows:

All flat cars that can be used for twin or triple shipments of lading, built after January 1, 1918, must have side stake pockets spaced minimum 2 ft. 0 in. and maximum 4 ft. After *January* 1, 1926, no flat car that can be used for twin or triple shipments will be accepted in interchange unless the side stake pockets are so spaced.

The Committee recommends the addition of a new section to Rule 3, to be designated as Section (q) as follows:

On and after January 1, 1926, no car will be accepted from owner unless equipped with an efficient auxiliary device for supporting brake beam in case of failure of brake hanger or hanger support.

The Arbitration Committee will also recommend to the Committee on Car Construction that it define what constitutes an efficient auxiliary device and manner of application.

The Committee recommends the addition of a new section to Rule 3, to be designated as Section (e) as follows:

"Cars built new after January 1, 1926, or new cars contracted for after January 1, 1925, will not be accepted from owner unless equipped with steel underframe meeting A. R. A. strength requirements.

Rule 14

C. F. Straub (Reading): There seems to be a confusion in different parts of the country about the proper designation on such cars or principally self-clearing hopper cars that have the empty and load brake that the brake cylinder rigging is at the *A* end of the car and the brake shaft is also at the *A* end of the car, but the cylinder operates towards the opposite end. Invariably inspectors get confused in claiming that repairs made at the *A* end were actually at the *B* end. It seems to me that is a proper question to get in the minutes so that the end to which the cylinder rigging is constructed is known as the *A* end. Many inspectors get it just the opposite.

Mr. Herbster: The end towards which the piston travels is always considered the *B* end. The location of the cylinder brake shaft or reservoir has nothing to do with the location of the end of the car.

Rule 17

The Committee recommends the following modifications of Interpretation 7 under this rule:

Interpretation 7 is the cause of complications, owing to difficulty in determining whether the patented brake connectors referred to are a standard of the car owner. A modified interpretation, to correspond with the regular practice of charging patented pressed steel journal boxes, would simplify the numerous billing transactions.

A.—The conditions are such as to justify a broad ruling on the basis of sections (b) and (f): Therefore, effective July 1, 1924, the material referred to, when conforming to A. R. A. standard, and subject to Rule 105, may be charged at stores department cost when applied in repairs to foreign cars on and after that date.

REASON—To clarify the rule.

The Committee recommends an additional interpretation (18) of this rule, as follows:

Q.—Is equipment stenciling required on cars for certain details, such as Type "D" Couplers and K1 or K2 Triple Valves, where the stenciled date built definitely established the standard of car?

A.—No.

REASON—To clarify the rule.

Mr. Owen: I would like to bring up a question under Rule 17, Item (b), on page 32.

It is permissible under that rule to substitute wrought iron for cast steel or malleable iron A. R. A. standards. In my opinion that rule should be extended to cover items that are not A. R. A. standard, such as wrought iron carry irons, brake hangers, brake hanger keepers, truss rod bearings, etc. Some railroads have malleable; some have cast steel carry irons, brake hangers, brake hanger keepers. They can all be forged in about the same design of equal strength, if not better, out of wrought iron. If you forge those items out of wrought iron to apply to a foreign car it is necessary that you issue a defect card, and yet they are all owner's responsibility. You would not be justified in holding up this car and ordering the cast steel carry iron from the owner when you could easily forge one and get the car moving the same day.

To expedite the movement of cars I would recommend that on such items as that their carrying point be allowed to use wrought iron and it would not be considered as wrong repairs.

Mr. Fitzgerald: We have already got a rule that protects the repairing line in connection with those items mentioned. Rule 88. You can substitute wrought iron and give the owner a defect card for labor only.

W. P. Elliott (Term. R. R. A. of St. Louis): Where is the protection?

Mr. Fitzgerald: Render a bill against the car owner for the material you put on the car. You give a defect card for the labor of correcting. He is entitled to it.

Rule 20

The Committee recommends that the second paragraph of this rule be changed as follows:

"When construction of car and trucks precludes the common methods of adjusting coupler heights, the application of metal shims, between journal boxes and arch bars *or truck sides* will be permissible."

Mr. Trapnell: We have done it for a long time. Now we are just getting absolute authority to do it.

Rule 30

The Committee recommends that Section (c) be changed as follows:
Wooden and steel underframe cars (except refrigerator cars) should be reweighed and remarked *once each twelve months during the first twenty-four months* the car is in service and thereafter once every twenty-four months. All-steel cars and all refrigerator cars should be reweighed and remarked at least once every thirty-six months. Such reweighing and remarking may be done after expiration of eighteen months (for wooden and steel underframe cars) and thirty months (for all-steel and all refrigerator cars) from the month in which previous weight was obtained. This paragraph does not apply to tank cars.

Mr. Trapnell: In other words, you bill the car on December 1 and on January 1 under the old rule you could reweigh the car and bill the owner. Now they put it in months. A certain number of months must elapse before you can penalize.

The Committee recommends that Section (f), Item 10, first paragraph, of this rule be modified as follows:
The weights of the car so obtained *must* be furnished immediately on the prescribed blank to the car marker, who will mark the cars as provided in paragraph (a). When desired, any portion of the marks which will not be changed may be marked on the car before reweighing.
REASON—To compel railroad performing work to furnish immediate advice and not compel owner to await receipt of the billing repair card.
The Committee recommends that Section (g) of this rule be modified as follows:
(g) When a car is remarked the car owner *must* be notified of the old and the new weights, with place and date. The proper officer to whom these reports should be made will be designated in "The Official Railway Equipment Register."
REASON—To compel railroad performing work to furnish immediate advice and not compel owner to await receipt of the billing repair card.

Rule 32

The Committee recommends that answer to Interpretation No. 4 be modified as follows:
Q.—Does a car damaged by wreck, derailment cornering, sideswiping or other unfair usage, as defined under this rule, carry the same responsibility to any other car in the same train or draft, or to cars to which the draft is being coupled, if said other car develops, at the same time, only minor defects?
A.—Yes, *except as provided in Rule* 33.
REASON—To clarify the rule.
The Committee recommends an additional interpretation to this rule, as follows:
(11) Q.—Please define Item 5, Section (d), Rule 32.
A.—This provision is intended to apply to damage to the first car when caused by engine coupling on and includes additional damage to adjacent cars in same draft.
REASON—To clarify the rule.

Mr. Elliott: I asked that question yesterday and the committee would not answer it.

Dome covers and safety valves were added to the rule two years ago, if I remember correctly, and it is not the amount of them that is lost that warrants very much discussion. I do not think there are many, but I just wondered who would take a chance on the life of a man getting up at night on the top of the car to see if it was there. I just wondered why that was in the rule, and if they realized the danger of inspecting the car to find out whether those things are there or not.

Mr. Trapnell: I do not think there is any danger if you properly equip your man for inspection of that kind of commodities. If you will furnish the man with a flashlight or with these electric lanterns that they have in oil firms, I do not think you would have any trouble.

Mr. Smith: I think the framer of that rule had in mind when he made the rule that it would compel the railroad on whose line the cover became loose to see that it was put on. In other words, the cover ought to be on when the car is unloaded. That is where it is usually removed. I think that was the intent of the rule.

Mr. Elliott: Yes; but the trouble is you take records when you make inspections to protect yourselves between lines. How is a man going to know that the dome cover is up there at night if he does not get up there? Not one per cent of the roads in the country provide flashlights. We tell a man to stay away from the top of the tank car and here we put something in the rules that virtually tells him he must go up there.

Mr. Smith: I think there will be less missing dome covers with the rule there than there would be without it.

Mr. O'Donnell: If we are going to pass Rule 32 I am going to appeal to the members here morally to uphold this rule. A lot of people are inclined to make it a laughing stock. I really think to expedite the freight movement throughout the country it is the very best we can have and our Arbitration Committee and our officials want us to work that rule honestly and justly. Why should we get picayune methods in there and try to get a few dollars on technicalities that do not belong to us? We should be big enough and broad enough to run our terminals so that any man found wanting in working out Rule 32, be he yard master, superintendent or anybody else, will be corrected. I think it will do our association good to show that we take such a stand.

C. M. Hitch (B. & O.): In connection with Rule 32, I do not believe we go far enough in advertising through our transportation department, particularly yard forces and trainmen, the contents of Rule 32, to enable them to qualify in getting information relative to damages. I have recently furnished our yard foremen, yard masters, etc., a copy of Rule 32, requesting that, when damages occur caused by any of those items mentioned, they report accordingly and I am getting some results.

I. E. Guthrie (N. Y., N. H. & H.): Rule 32 on page 64 of the present rule book states: "No rider protection when necessary, if car is damaged to the extent shown in footnote to Rule 43, it is an owner's defect." I would like to have that interpreted here.

Chairman Westall: I think that is the understanding.

Mr. Cheadle: Mr. O'Donnell expressed my views when he said the tank company has offered all the protection that they can on these different parts; that is the cover and the cap; but yesterday the committee in answering a question as to whether caps are cardable in interchange said that this defect is cardable. Afterwards my attention was called to the fact that that portion of the outlet belt is not chained or tied in any way so that it would not become loose. It seems to me the railroad ought not to be responsible for the loss of a nut or plug used there.

Mr. Trapnell: If I remember, the committee on handling the nipple proposition on the bottom of the outlet cap reported that that would not be cardable.

Chairman Westall: Delivering line.

Mr. Trapnell: I do not see how you can make it the delivering line, because it is not the cap. It is only part of the cap.

Mr. Elliott: We went along for years in an unsatisfactory manner and we got to the point where we had joint inspections to certify whether the defects are new or old, etc. Rule 32 takes the opinion away from the car men altogether. You have nothing to say. It is the switchmen in the yard. The carmen have nothing to do about it now.

A. G. Hill (F. W. & D. C.): The protection given the tank car people for the missing dome covers, safety valve and outside cap is a good big item in our territory. We have a great many refiners on our line and sometimes the requested defect cards are for missing dome covers, etc. It runs into two and three hundred dollars a month from refineries where there are inspectors maintained. It is a big item for the tank car man.

Rule 33

Mr. O'Donnell: May I ask a question on Rule 33, while we are in that vicinity? Are repairs to safety appliances chargable to car owner on car derailed, cornered, sideswiped or subjected to any other Rule 32 condition where there is no other delivering line damage on the car, it being understood that damage to running boards on tank cars due to sideswiping and cornering is never chargeable to owner? Should they go to the owner?

Mr. Trapnell: Yes, sir.

Rule 36

Mr. O'Donnell: When you are removing the placards from tank cars, is it necessary that you cut the car in and delay it and wash it with hot water, or can we use the in-

spector's hook and take off the word "inflammable," and get most of it off, and call that a removal?

Secretary Sternberg: I would say not. You must get them off entirely.

Mr. O'Donnell: You are going to delay a lot of cars.

Mr. Trapnell: I think at our last meeting, Mr. Fitzgerald went on record as stating that five defect cards were issued for the removal of one placard from one tank car. If you are getting paid for it, do it the way you should.

Mr. O'Donnell: Mr. Aishton says every additional mile the car makes means a hundred thousand cars a month. Now, are we co-operating broadmindedly in that work or are we simply saying "that is none of our business"? I claim when you take the major portion of the reading off, nobody kicks. Am I right?

Secretary Sternberg: I cannot agree: I think the A. R. A. has made the rule for us to work by and they say nothing about delay to the cars. If we do not remove that placard in the proper way or obliterate it so it does not show, we must issue a defect card for it.

F. C. Schultz: If you expect to get paid for this work, you must remove the placards for the reason already explained, and I think the interpretation says you can't paint them over.

J. E. Vittum: I think we have never had a case where they were painted over, and it is our practice at Columbus to remove them entirely.

Rule 43

The Committee recommends that the note to this rule be modified as follows:

PROPOSED FORM—Note.—The handling line must furnish statement showing the circumstances under which the following damage occurred, if it is claimed the damage was result of ordinary handling. This statement, in the case of cars reported under Rule 120, to accompany request for disposition of car, and in cases where it is not necessary to report car under Rule 120, to accompany the bill for repairs:

(1) Six or more longitudinal sills on wooden underframe cars.

(2) Five or more longitudinal sills on composite wooden and steel underframe cars.

(3) Four or more steel longitudinal sills on steel or steel underframe cars.

(4) All longitudinal sills on all-steel underframe cars having but one steel center member.

(5) Two steel center members on tank cars having two steel longitudinal sills only.

(6) Steel tanks of tank cars shifted where secured by bolster or center anchorage.

REASON—The statement referred to should be furnished for steel underframe cars having one steel center member and for steel tanks of tank cars shifted where secured by bolster or center anchorage.

The Committee recommends an additional interpretation to this rule, as follows:

(2) Q.—Is damage to tanks of tank cars, caused by internal pressure of liquid, owner's responsibility?

A.—Yes, provided car was not damaged under any of the provisions of Rule 32.

REASON—To clarify the rule.

Mr. Elliott: On shifting tank cars, we have a number of cases, I think, where that should have been clarified, where the cars meet the A. R. A. specification of rivet shearing area. I had occasion a few years ago to check up a tank and found that the tank did not have sufficient rivet shearing area. I went into it then and checked a number of other cars and found there were a number of tank cars that did not have sufficient rivet shearing area. I suppose we are not making recommendations here, but I think that should be interpreted in that rule, because I am satisfied they do not want to penalize a handling line where the car is not properly built in the first place. At the proper time that could be taken up, and I suppose in the meantime if we had a case we could refer it to the A. R. A. Arbitration Committee.

Mr. O'Donnell: I would like to know what they mean by "internal pressure"; whether it is the swash of the liquid or internal pressure, or pressure on that basis.

Chairman Westall: I took that as the pressure of the liquid, but Mr. Chapman seemed to think differently.

Mr. O'Donnell: Well, it is a question we have got to pass on. We have got two cases where the end of the tank has been torn out, due to surge of the liquid.

Mr. Trapnell: I take it that this internal pressure means where they handle a car and do not give it proper ventilation and it soaks or sifts down at the bottom. We have had a couple of cases like that, where there was no evidence of derailment, no evidence of cornering, no evidence of anything falling on the car, but that was the condition as we found it, and we so passed on it, and made the owner responsible.

Mr. O'Donnell: Did he accept it?

Mr. Trapnell: He did.

Mr. O'Donnell: This tank I have in mind gave way right at the top of the shoe, where the shoe was riveted; went right across the shoe and then went up two feet. Now, we lost about 5,000 gallons out of 6,500. The bill for that was held. Now, that was caused by ordinary surging in the tank, I suppose.

Mr. Herbster: We have had two cases where the end of the tank came out without any fracture visible at the circle.

Mr. Trapnell: Only on the inside?

Mr. Herbster: Not on the inside. One case happened in the stock yards and there was not anybody able to see what caused it, and there was no evidence of Rule 32 conditions. The owner naturally thought that the handling line was responsible. It is my opinion that where internal pressure is exerted, either by vapor or swashing, the handling line is responsible.

Mr. Trapnell: I would like to ask Mr. Herbster what the safety valves on those tanks are for.

Mr. Herbster: The safety valves on those cars were not operating.

Mr. Trapnell: You don't get any pressure on that tank sufficient to take out the head.

Mr. Herbster: The head was out.

Mr. Trapnell: Did you go inside the tank?

Mr. Herbster: Yes, sir.

Mr. Trapnell: And did you steam it out?

Mr. Herbster: No, we did not.

Mr. Trapnell: Then you didn't go inside to find out whether there was a fracture in there or not.

Mr. Herbster: In one case we washed the fractured part of the tank with gasoline in order to determine whether there was a fracture or not, but did not find it.

Secretary Sternberg: It appears to me that if a tank is up to specifications any internal pressure that would force the end out would be an owner's responsibility, according to this rule. I think that settles the thing thoroughly.

Rule 60

The Committee recommends the following interpretation to this rule:

(4) Q.—In case air brakes are cleaned within nine months from date of last previous cleaning, may owner be billed for the work?

A.—Yes, when either triple valve or brake cylinder is found defective, unless air brakes are cleaned more than once on same road within sixty days from date of initial cleaning, in which case charge for subsequent cleaning is not permissible, regardless of whether previous cleaning was charged.

(5) Q.—In view of air brake stenciling on reservoir of tank cars being obliterated by slopping over of oil or other contents, is there any objection to relocating this stenciling on reservoir side of center sill at center of car on such tank cars as have only two longitudinal sills?

A.—On tank cars of this type there is no objection to this practice.

(6) Q.—Is it permissible to render bill for cleaning air brakes where air test is not given to the individual car, in accordance with standard instructions for annual repairs to air brakes on freight cars, after repairs?

A.—No, each car must be tested separately.

REASON—To clarify the rule.

Mr. Cheadle: We find cases of cars being returned where we have every reason to know that the stenciling on the cylinder is the clean date, but that the stenciling on the opposite side of the car is old. The men who are doing the work do not think to look all over the car to find it, yet the evidence is there and they come back and ask for recharging authority. There is nothing else to do under the rule but give it to them.

Mr. Owen: We recently had a case of air brake cleaning in 1924, and two months after that the owning line came back with joint evidence that the old stencil marks dated 1918 and 1921 were not properly obliterated. I traced the car and found that the air brakes had been cleaned four

different times and those old stencils not painted off, which were on the inside of the cylinder, on what you term the right hand side. I was under the impression that the joint evidence was final and that we would have to issue our counter billing authority, but I traced the car and found that since 1921 it had moved off and on the owning road forty-eight different times. They had not seen fit to correct or paint out that old stenciling from 1918 until 1924, one month after we had cleaned the air brakes. Instead of submitting the case to arbitration, it was withdrawn by the owner.

Mr. Fitzgerald: A number of railroads are not complying with the regulations in connection with stenciling the date of cleaning air brakes. Those roads that are putting more than one stencil on cars should issue instructions on their lines to eliminate the double stenciling.

Rule 68

The Committee recommends the following interpretation to this rule:
Q.—Is the delivering line responsible for a wheel slid flat and having worn flange, each defect exceeding condemning limit?
A.—Yes.
REASON—To clarify the rule.

Mr. O'Donnell: I want to ask a question on the length of the slid spot. If we have one wheel up to the limit of 2½ in. and the other one has slid only ¼ in. does the same responsibility exist? Do you scrap those two wheels?

Mr. Trapnell: I say, according to the law, we would.

Mr. O'Donnell: What do you do with that good wheel?

Mr. Trapnell: We remount it.

Mr. O'Donnell: You give cards right along on that basis?

Mr. Trapnell: There is no getting away from it.

Mr. Cheadle: I am familiar with the practice of a great many roads and I know there are one or two condemning the wheel and others that do not.

Mr. Trapnell: That is what I have been going to say, if you remove the wheel you would have to give the owner credit.

Mr. G. Lynch (Cleveland, O.): What disposition do you make of the wheel that is slid ½ in. and with a wheel that is slid 2½ in. or over? Also, how do you arrange in billing, if you appropriate the wheel for your own use? Do you give credit for it as a second-hand wheel or do you scrap it?

Secretary Sternberg: I would say yes, Mr. Lynch, if we get a defect card for two slid flat wheels, we would certainly scrap them both. If we only get a card for the one and not the other and it was fit for service, we would put it in the second-hand class and use it again.

Mr. Smith: I think this is another case where we all ought to be honest. I think the rule means that it is up to the receiving line to decide whether they are going to use that wheel again or not, and act accordingly. If the wheel has a ¼-in. slid flat spot, the chances are that we will use it again, and if we use it again, I don't think we ought to bill the party issuing the defect card.

Mr. O'Donnell: Should the chief inspector, in his conscience, give a card for two wheels? I think the evil should be stopped when it starts. If we examine those wheels and we find one wheel mated on that axle is just skimmed, I believe there should be a card on only one wheel. I think we ought to treat that money just the same as our own money. That is the reason I don't feel right in giving cards unless you know what you are going to do with that wheel. The average credit, prior to 1920, didn't matter. Second-hand and scrap were all on the same basis, but now there is a difference and you have got to consider it.

H. Andrew (N. Y. C.): From a mechanical standpoint, it is often absolutely impossible to find a wheel to mate with the ¼ in. slid flat wheel. Then again, the Arbitration Committee has provided in the remounting of second-hand wheels that certain conditions which prevail will condemn the wheel and make the delivering line responsible. Until the present rules, it has been impossible to re-bore cast iron wheels over and above the maximum bore which was specified under the rules. Now we are permitted to exceed that by 1/16 in. in order that it may be possible to remount second-hand wheels and put them into service. It rests with the mechanical department as to whether they can use the slid flat wheel, and have you any right to say, "this wheel is fit for service," when it cannot be remated or the bore is excessive? I think the joint inspector has no jurisdiction in this case.

Mr. O'Donnell: I would like to answer that question by asking: Why do the Arbitration Committee and the Master Car Builders' Association give us the right to force the receiving line to take wheels if they are within the 2½-in. limit? Those wheels are not condemnable. If we have a pair of wheels coming from one road to another, and the wheel is slid ¼ in., isn't it just as bad to put that wheel in the shop and call it scrap? I want to know whether we are going to dip our hands in the delivering line's treasury. I claim there should be in the billing department a tacit understanding that if you get a car having a pair of slid wheels, if two of those wheels are good, you should allow proper credit to the delivering line.

Mr. Cheadle: May I ask why all this discussion? Why not have a recommendation as Mr. O'Donnell says? Inasmuch as the rules are plain, let us live up to the rules. Let the mate wheel carry the same responsibility.

Rule 70

The Committee recommends that the first two paragraphs of this rule be modified as follows:
PROPOSED FORM—Delivering company responsible.
Cars stenciled "wrought-steel wheels," if found with cast-iron, cast-steel, or steel-tired wheels.
Cars stenciled "cast-steel wheels," if found with cast-iron or steel-tired wheels.
REASON—The status of the steel-tired wheel is not such as to require the protection of this rule.

Mr. Cheadle: I would like to ask about the stenciling of the car. In a great many cases, where cars on certain railroads are known to inspectors, the steel wheel is standard to them, and they don't wish to call for joint evidence because they know and can see a portion of the stenciling left on the car, but in the last 12 months I have observed many cars on which a man who was not familiar with that series of cars could not tell whether the car was stenciled "wrought-steel wheels" or not. It certainly puts the intermediate line, or the second intermediate line in for an unjust responsibility. I know of one case where the only remaining indication on the car that it was stenciled "wrought-steel" was where it had the small end of the letter "T" stamped on it. The man saw the end of the "T" and gave a defect card, and yet that line was in no way responsible for the car. I want to mention that because those who are familiar with the construction of the car ought to go further in maintaining the stenciling. It has given a lot of trouble on my end of the road.

Mr. Trapnell: I will agree with Mr. Cheadle that we have many cars running over the country that you can't get the number and initial of. And yet here is a man who receives a car at night, in the small hours. He has a small lantern, and in looking over the car cannot find any stenciling on it, but his line is penalized because he does not find something that was stenciled on the car. I contend that, being the delivering line's responsibility, it should absolutely be placed in joint evidence, so the man who committed the crime will be the one penalized.

Rule 93

The Committee recommends that the second paragraph of this rule be modified as follows:
PROPOSED FORM.—All charges for repairs made to cars on account of owner's defects, defect cards and rebuttal authorities shall be consolidated against any one company into one bill.
REASON—Balance of rule is out of date.

N. M. Pyle (S. P. R.): All charges for repairs made to

cars on account of owner's defects, defect cards and rebuttal authorities shall be consolidated against any one company into one bill. I try, in rendering bills, to live up to the instructions given by the different roads in the equipment register and the rules. I have in mind at the present time a bill rendered against a railroad applying door protection on authority of a transfer card as issued. Now, in rendering that bill, I referred to the equipment register. There is nothing in there that says that bills of that nature shall be rendered separate from car repair bills, so I included that bill. It is a transportation bill, but still it is an operating expense, and I included this amount in my regular car repair bill. Now, the road I billed for this is requesting that I eliminate from the car repair bill that amount and render a separate bill. I would like to know what the practice of others is in order that I may correct my practice if I am wrong.

Secretary Sternberg: I think you will have to separate it because the transportation bill cannot be included with car bills.

Mr. O'Donnell: All those bills are made separate upon the A. R. A. bills in our district.

Chairman Westall: We have finished the freight rules and all that is left, I believe, is the passenger rules.

Mr. Trapnell: I think that the passenger changes are only in conformity with the freight rules to bring them up to date and that can easily be handled by each individual. As it will not require any discussion, I move you that the rules stand approved as we have had them so far, including the passenger rules, to save the reading.

(The motion was seconded and carried.)

Additional Business of the Association

The members voted to give more time to the discussion of A. R. A. rules of interchange, repair, billing and loading as this is the primary function of the Chief Interchange Car Inspectors' & Car Foremen's Association. On motion of Mr. Trapnell, the association voted to devote the entire second day of next year's convention to the consideration of these subjects.

Amendments to the constitution were adopted to provide for a third vice-president. The retiring president will become chairman of the executive committee to consist of seven elective members and the past presidents. The term of office will be one year except for the executive committee, in which case the term will be two years. The dues of active and associate members of the association were made $3 a year payable in advance and the secretary's salary was increased to $300 a year.

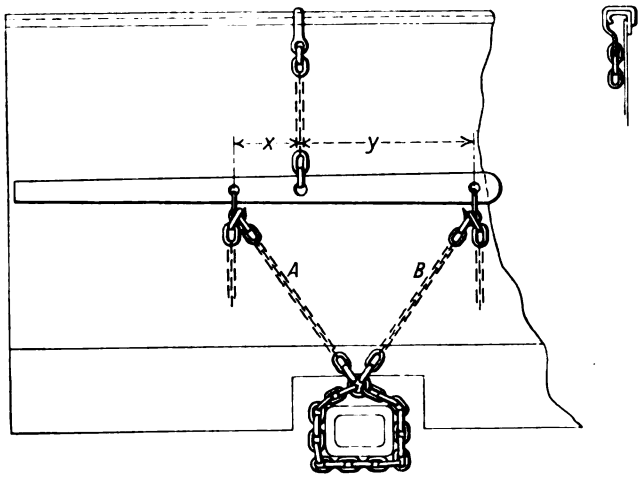
Prizes for securing the largest number of new members during the year were awarded to E. R. Campbell, general car foreman, Minneapolis Transfer Railroad, Minneapolis, Minn., who secured 80 new members; W. R. Rogers, chief interchange inspector, all roads, Youngstown, Ohio; B. F. Jamison, special traveling auditor, Southern, Meridan, Miss., and H. J. Budd, Boston & Maine. The prize consisted in each case of a card which entitles the recipient to a copy of the 1925 edition of the Car Builders' Cyclopedia which is now under preparation and the first copies of which will probably be received from the printer early in January of next year.

For the association Mr. O'Donnell, chairman of the committee on resolutions, extended thanks to R. H. Aishton, Charles Dillon and W. F. Brazier, for addressing the convention; also to President Westall and Secretary Sternberg for the effective way in which they conducted the affairs of the association during the year. A vote of thanks was extended to W. T. Walsh, president of the Supply Men's Association, for the exhibition and entertainment provided. The 1924 convention was then closed with prayer by Mr. Jamison.

Hoisting Lever for Applying Couplers

One of the most common jobs with which a carman assigned to an outlying car repair point has to contend is that of repairing or replacing broken couplers, coupler yokes and draft gears. The most difficult part of the job is raising the coupler into position for application. By the use of the lever hoisting device shown in the sketch, one man can easily lift a coupler, with the yoke attached, to its place between the draft sills on the car.

This device is easy to construct and operate. The lever is fulcrumed to a chain which is hooked over the end of the car and two chains, *A* and *B* are secured to the lever and coupler shank as shown in the sketch. The lever hook for the chain *A* is located a shorter distance *X* from the fulcrum on the



Sketch Showing a Hoisting Lever by Which One Man Can Raise a Coupler into Position

lever than the hook for the chain *B*, which is located at a greater distance *Y*. The distance *Y* must be considerably greater than *X* to give the operator a greater leverage and hoisting distance for each movement of the lever. To operate the hoist the repairman stands on the end sill of the car and pushes down on the lever handle. This movement causes the chain, *A*, to be slacked and the entire weight of the coupler is carried on the chain, *B*. The slack of the chain, *A*, is then taken up and the weight is transferred from the chain *B* by slightly raising the lever handle. The slack is then taken up in the chain, *B*, and the operation is repeated until the coupler has been raised to the desired position.

Interior View of the Angus Steel Car Shops of the Canadian Pacific, Montreal, Que.

Safety Work in the Car Department

Duluth, Missabe & Northern Works 2,412,800 Man-Hours with Single Accident

By W. A. Clark

General Car Foreman, Duluth, Missabe & Northern, Proctor, Minn.

This article is an abstract of an address by Mr. Clark at the thirteenth annual congress of the National Safety Council held at Louisville, Ky., October 1, 2 and 3. The safety measures outlined in the article are particularly significant and valuable because they work. From October 16, 1921, to September 1, 1924, when the address was prepared, the car department of the Duluth, Missabe & Northern had only one accident disabling an employee for more than one day. In other words, a period of 34 months elapsed with but a single accident and during this time 2,412,800 man-hours of work were performed. Mr. Clark generously gives credit for this splendid performance "to the management which provided every facility to make conditions safe, to the safety department under the direction of A. V. Rohweder, which labored continuously to instill the safety spirit and to each and every supervisor and safety committee member of our department."—EDITOR.

GENERAL car shop work in the nature of repairs both heavy and light presents unlimited possibilities for injuries. The operation of each shop will have problems of its own: the shop served with cranes and where jacks are not used; the shop that is without cranes and where jacks are used; points where inspection and repairs are made to equipment in yards and terminals.

The supervisors in charge of new work or the rebuilding of cars must be ever alert to see that the maximum admissible floor space is kept free from stumbling, falling, and tripping hazards; that material is safely piled, and that proper and necessary scaffolding is provided; that goggles are furnished and worn when drilling, reaming, chipping, and riveting is being done; that riveters and helpers have a tight band or handkerchiefs around their necks to protect their backs and gauntlets or tight sleeves to prevent hot rivets from going up their sleeves.

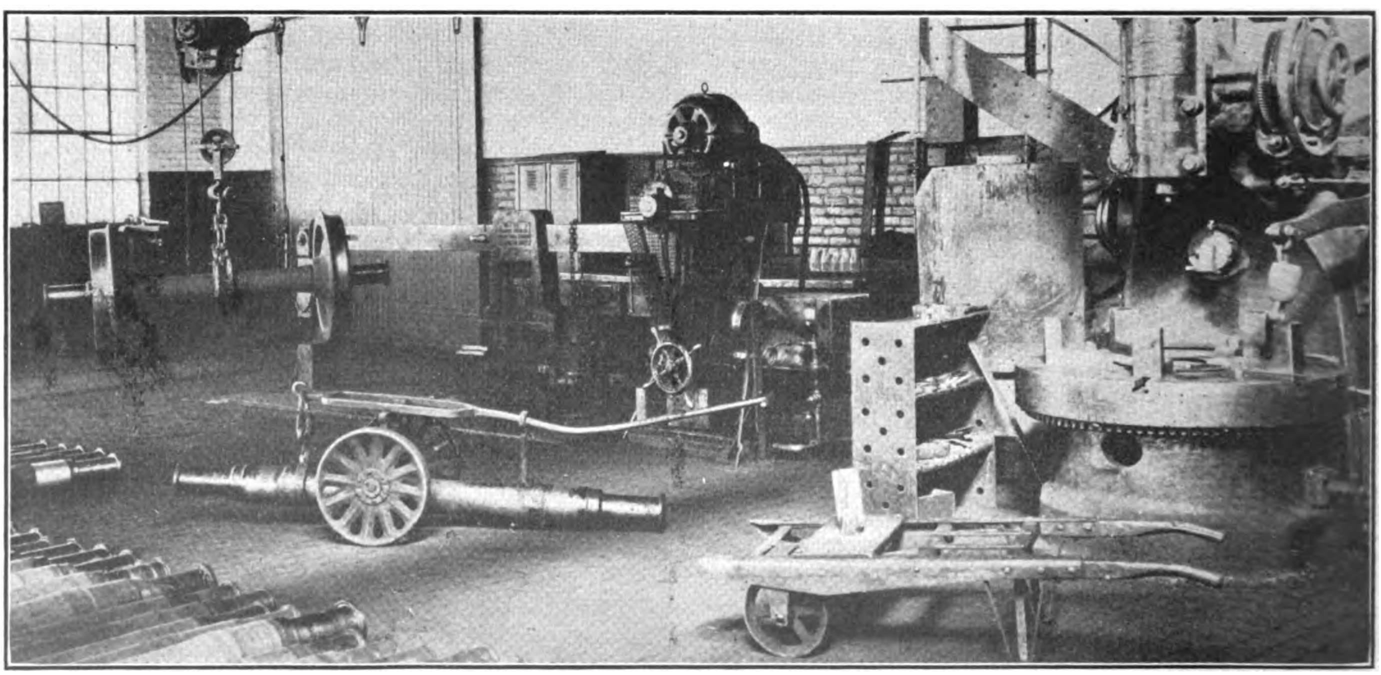
In handling structural steel and plates with cranes, safety hooks should be used. One man only should give signals to the crane operator, and when cars are moved to new positions by cables or cranes, operators should be instructed not to take signals to start or move a crane or car along the tracks until some competent person is stationed at the end of the car in the direction it is to be moved, to make sure that no one is in the way, or that no men are underneath, between, or in the hopper openings.

Trestles, horses and scaffolding should be standardized, regularly inspected and kept in a safe condition. All ladders should have safety ends and all scaffold planking have a bolt running through each end to prevent splitting. On each end of scaffold planking cleats should be nailed to prevent planks from slipping off the ends of trestles.

Absolute confidence should not be placed in the reliability of jacks. Horses should be used as an auxiliary in all cases where men have to go under car bodies. Also an absolute rule should be made that no man be allowed to expose his body or limbs between trucks and frame of car until proper blocking is placed between the truck bolster and the car, or under the side bearings.

To prevent men from putting their hands on the inside of cranes hooks or taking hold of cables while lifting cars, a handle should be put on the hook on the opposite side from the point, and all concerned properly instructed in the safe method of handling hooks or cables.

The removal of stuck or wedged friction gears should be properly supervised. Inexperienced men should not be



A Corner of the D. M. & N. Wheel Shop at Proctor, Minn., Showing Safety Hook or Tongs for Handling Mounted Wheels, Axle Truck and Truck for Handling Unmounted Wheels

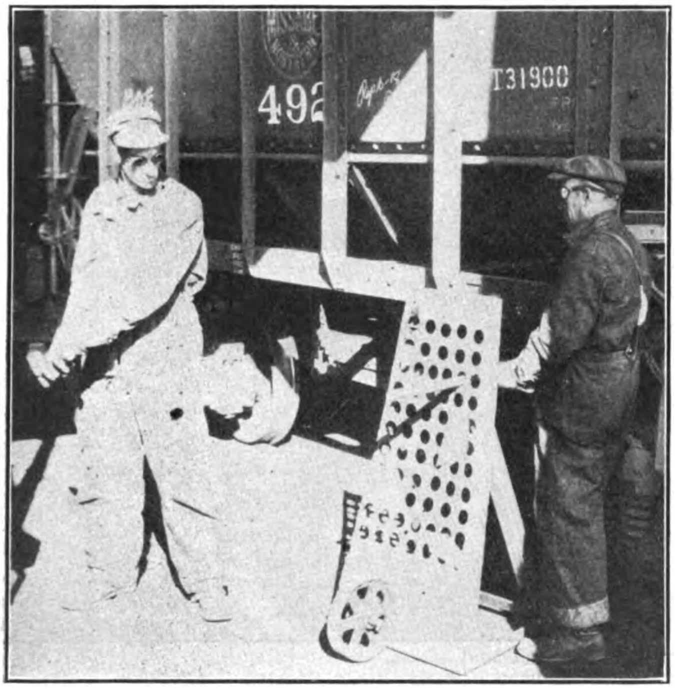
allowed to handle them. When removing supporting plates and couplers from cars, air jacks on trucks, or blocking should be used to prevent couplers and draft gears from falling to the floor when nuts are removed from carrier iron and supporting plate bolts.

Extra precaution and care must be used in blocking box car bodies to make them safe when trucks are removed on repair tracks not protected from winds. During high winds the number of trestles or horses should be doubled.

General Rules

No tools, car parts, knuckles or knuckle pins should be left on platforms, ends or tops of cars while cars are being repaired.

No passenger, baggage or caboose equipment should be sent to shops for repairs or men allowed to work on them until all torpedoes have been removed.



Chisel Bar Guard for Use in Cutting Rivets with Chisel and Sledge

Striking truck springs with hammers or sledges to drive them in place is dangerous. When necessary to do this a block or piece of wood should be used between springs and hammers.

An inflexible rule should prohibit the practice of men putting their hands on center pins to guide them in place while lowering car bodies on trucks. Also blocks should be used under all conditions of service that require men to expose their bodies or limbs, under any part of a car that may be raised or jacked up, or held up with a bar. This practice is the only one that will prevent crushing, and maiming should the parts move, slip or fall.

Car men should not be allowed to raise steel doors, bolsters or other parts with bars, and other men expose their hands or fingers until the part raised has been made safe by blocking securely. Then should the bar slip the man with his hand exposed will be safe.

All tools should be inspected daily, defective ones removed from service and a place provided for tools that become defective or unsafe while being used. That is, a tool that has become defective should not be placed in the workman's tool box; it should be removed to a place designated for defective tools. Pneumatic hammers for car work should be fitted with inside triggers and safety retaining clips. Air hose and fittings should be inspected weekly for loose clamps and soft inside linings. The use of oil should be prohibited in the mounting and the repairing of air hose fittings.

Acetylene and oxygen gas lines and fittings should be inspected and back pressure valves filled daily if necessary. All defective gages, regulators and torches should be removed from service and returned to the maker or company making repairs. The mounting or fitting of gas hose should be done by or under the supervision of a competent welder. No one should be allowed to use the acetylene outfits until they have been thoroughly instructed in the use of regulators, gages, and torches; in the danger from oil coming in contact with oxygen gas; and the safe handling of gas tanks under pressure, and passed on as being competent by a regulator instructor.

Cutters and welders should be chosen with due regard to ability and fitness for such work, and thoroughly instructed in the care necessary to handle gases under pressure and not allowed to work alone until their instructor is satisfied that they understand how the regulators, gages, and torches should be used without endangering themselves or their fellow workers.

Machine Shop

The handling of unmounted wheels is best done by the use of a truck designed to prevent wheels from over balancing or falling. The element of risk is ever present when rolling them on their flanges. Unmounted wheels should be piled and blocked to prevent them from falling or tipping forward. Axles should be stored in a manner that will keep them from slipping. Operators of such machines as the wheel borer, axle turner, bolt cutter and punch and shear must wear goggles while working on their machines. Lifts, hoists, cables, hooks, and slings should be kept in good condition.

Safety Hooks with Pins Permanently Attached for Use in Hanging Sheets in Place on Steel Cars

Wrenches, hammers, or any object falling from the throat or head and striking the tripping lever of punch and shear machines may result in a serious injury. Therefore, this particular lever should be covered or protected in a manner

to make the machine operative only when the lever is pressed by the foot of the operator.

Air Brake Work

While cleaning brake cylinders use a safety clamp around the piston sleeve with a ½-in. bolt. Placing a nail in the sleeve in place of a clamp, is not a sure method of preventing injuries.

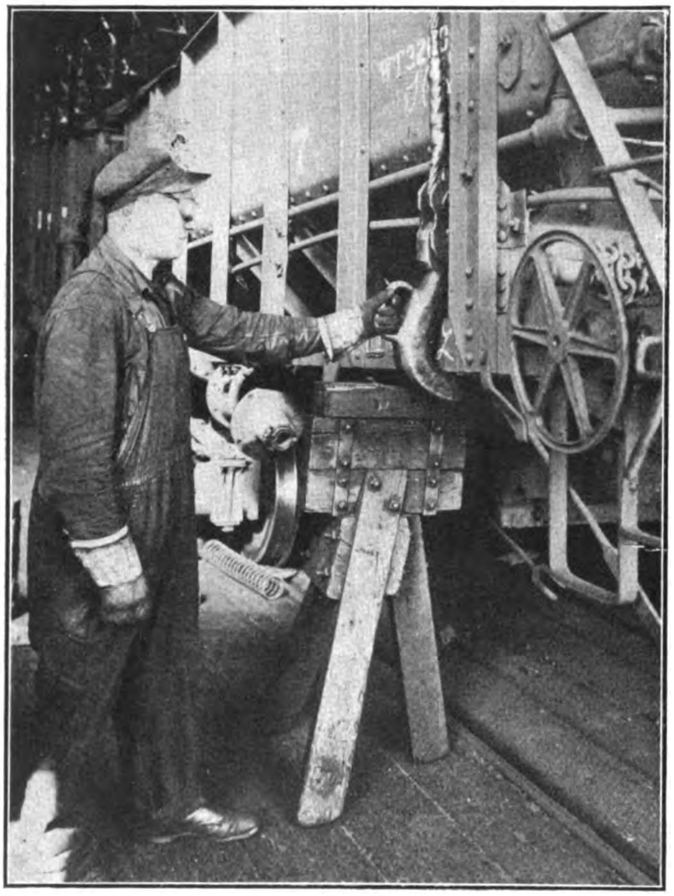
When testing brakes, see that the cut-out cock is closed and pressure allowed to escape from the reservoir before making adjustments. This will prevent the workman from being struck by levers. Also use a key bar in the key hole to pull it in line, instead of attempting to do this with the fingers.

Air hose used for testing cars or trains should have a drain cock in the hose head to reduce the pressure before uncoupling and to prevent particles of dirt being blown in the workman's eyes.

Pipe wrenches should be maintained in a safe working condition to prevent them from slipping and injuring the operator.

Paint Shop, Blacksmith Shop and Wood Mill

In the paint shop, ladders, horses, scaffold plank, paint burners, benzine, gasoline, lye, caustic soda, and acids,



A Crane Hook with a Safety Handle

slipping and falling from ladders and roofs are the most prevalent causes of injuries to be guarded against.

In the blacksmith shop, burns from scale or handling hot iron, contusions from iron falling or being knocked from power hammer and when cut at anvils, and chips from the heads of battered tools are the principal causes of injuries.

Wood working machines in the wood mill should be rigidly guarded. Guards must be kept in condition and none but competent or experienced operators allowed to use the machines. Operators of wood working machines should be taught the proper position of their hands. A man trying to see what is going on in other parts of the shop will not make a safe wood mill employee.

Yards and Terminals

Inspectors light repair men, air men and oilers work in yards and terminals. It is necessary to see that these men are constantly reminded that switches must be locked or blue flags or lanterns used before going between or under cars. They must be taught to walk between tracks instead of between the rails while on duty, and when it is necessary to cross tracks stop and look in both directions. The practice of car men getting on or off moving trains should be prohibited.

Using a Broom When Backing Out a Rivet

Wrecking

Wrecking foreman should be thoroughly trained in safe practices. The necessity of using outriggers and clamps, preparing a safe foundation for the crane before taking a heavy lift, properly blocking the crane and having reliable men follow up and tighten the wedges and blocking wherever the strain or load is removed from the boom, should be stressed. An efficient lighting system for night work should be provided.

The practice of securely blocking overturned or leaning cars and engines, before men are sent underneath, keeping men clear of chains or cables while pulling or lifting, are a few of the things a wrecking master must do if he is to keep his crew safe from injuries.

Safety Enthusiasm Needed

After all details of mechanical safeguards have been perfected it will be apparent that the ideal or true spirit of safety must come from the supervisors. Success in safety work must start or emanate at the top. Enthusiasm for safety should radiate from the head of the department. Interest and success in safety work depends on the attitude of the supervisors.

The supervisory forces must plan and lay the foundation if they aspire to build a monument to safety. No supervisor or safety committee member should allow any unsafe prac-

tice to go unchecked. The duties and responsibilities of supervisors must reach farther than guarding the machinery and providing mechanical safety devices.

After this has been done the men or workmen must be educated to the point that they will guard themselves. All new men should be thoroughly instructed in the hazards of the work assigned to them. This should be done by the foreman hiring them and again by the foreman in charge of the department they are assigned to. As the individual becomes more careful the morale of the organization will improve. Obstacles in the road to accident prevention will have disappeared. The results will be a larger output and a better class of work.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Repairs Claimed and Not Made

The Terminal Railroad Association of St. Louis on May 10, 1921, rendered to the Mather Stock Car Company a bill amounting to $2,543.01, covering charges for repairs during the months of February and March, 1921, and also, a few repair items leading back to October, 1920. Exceptions were taken by the car owner to the number of charges rendered for knuckles, knuckle pins, knuckle locks, brake shoes and a few other items on the cars which were repaired during the months of February and March, 1921, in the stock yards, prior to sending the cars to the loading chutes. The Terminal Association in its statement pointed out that the work of conditioning stock cars passing over the repair tracks of the East St. Louis Junction Railroad at the National Stock Yards, was performed by an inspection and repair organization operated under the auspices of the Superintendents' Association of the St. Louis-East St. Louis terminal district. The repair and inspection work was formerly handled by car department men of the individual railroads handling stock or other shipments in or out of the yard. Without citing a specific instance of overcharge, the owner endeavored to prove that the cost of repairs made by the unified car department forces averaged, approximately, 84 per cent in excess of the same work done at its own or contract shops. This claim was based on the amount and the cost of work performed by the owner's repair men, established at the stock yards, during a period subsequent to May 21, 1921, the items of which were checked against the bill in question rendered by the T. R. R. A. The Mather Company suggested to the Terminal Association two different joint investigations, which the latter refused to make on the grounds that the repair car stubs could be checked with the original record. The owner objected to this, claiming that the original record was wrong as the repairmen wrote up these records and in order to make a good report, often indicated repairs that were not made. They also were expected to do a fixed minimum amount of repairs every day under the A. R. A. rules which the owner believed, accounted for the results shown.

The following decision was rendered by the Arbitration Committee: "There is no evidence presented that would show that these repairs were not made as billed. Decisions 1017, 1018, 1057, 1080, 1088, 1108, 1130 and 1233 apply." —*Case No. 1308, Terminal Railroad Association of St. Louis vs. Mather Stock Car Company.*

Responsibility for Car Destroyed by Fire

At 11:25 p. m., January 25, 1923, the Kansas City Terminal delivered a transfer of 16 cars to the Chicago & Alton's Twelfth Street yard at Kansas City, Mo. W. H. T. X. car No. 200, loaded with gasoline and leaking, was included in this transfer. Fifty minutes after this delivery had been effected, W. H. T. X. car No. 200 was discovered on fire and was destroyed. The Chicago & Alton refused to assume responsibility for the destroyed car on the grounds that the car was leaking when taken by the Kansas City Terminal from its Mill Street yard and was still leaking when placed on the interchange track or in the Chicago & Alton's yards. Rule 2, section B., paragraphs 1 and 2 of the A. R. A. rules was quoted, and also paragraph 1909 from the Interstate Commerce Commission regulations, which both indicated that whenever a tank car loaded with an inflammable liquid is discovered leaking in transit, all unnecessary movement of the car must cease until the unsafe condition of the car is remedied. The Kansas City Terminal based its claim on statements taken by Terminal and Alton officers from those employees who handled the car, which indicated that the car had not been leaking at the time it was pulled from the refinery and that it was handled fairly between this point and the Chicago & Alton's yard. Rule 6 of the by-laws and rules of the superintendents' association of Kansus City was also quoted to substantiate the statement that the car had been delivered to the Chicago & Alton.

The Arbitration Committee rendered the following decision: "It is admitted by the Kansas City Terminal that this tank car was leaking gasoline before offered in interchange and that they failed wholly to remedy this condition; the tank was still leaking when the car was moved by Kansas City Terminal to the Chicago & Alton lines, which movement was a violation of Paragraph 1043 of Interstate Commerce Commission regulations. There is no evidence that the car was accepted by the Chicago & Alton. Responsibility for damage to car, therefore, rests with the Kansas City Terminal."—*Case No. 1310, Chicago & Alton vs. Kansas City Terminal.*

Responsibility for Wrong Repairs

The New York, New Haven & Hartford on March 18, 1920, at its South Boston shops removed, repaired and replaced a brake shaft on A. T. & S. F. box car No. 25061. On May 24, 1921, at Richmond, Cal., the A. T. & S. F. obtained joint evidence in accordance with Rule 12, showing one brake shaft 1¼-in. by 12-ft. 2-in. instead of one brake shaft 1¼-in. by 12-ft. 7¼-in. and made standard repairs at the same point June 4, 1921. In accordance with Rules 12 and 13, joint evidence and the billing repair card were forwarded to the New York, New Haven & Hartford and a defect card requested to cover the wrong repairs which it perpetuated. The repairing line refused protection, contending that it was not in position to know what length of brake shaft was standard to the car.

The Arbitration Committee rendered a decision to the effect that while the A.R.A. Standards mention no minimum length of brake staff above the ratchet wheel other than the required clearance around the brake wheel, the car owner must be protected against deviation from its own standard length. Providing the New York, New Haven & Hartford had straightened and replaced the same brake staff that was removed it is not responsible for the wrong repairs. If another one was substituted or alteration made in the length of the brake staff removed and replaced it is responsible for wrong repairs.

This decision supersedes the decision in case No. 695 to this extent.—*Case No. 1313, Atchison, Topeka & Santa Fe vs. New York, New Haven & Hartford.*

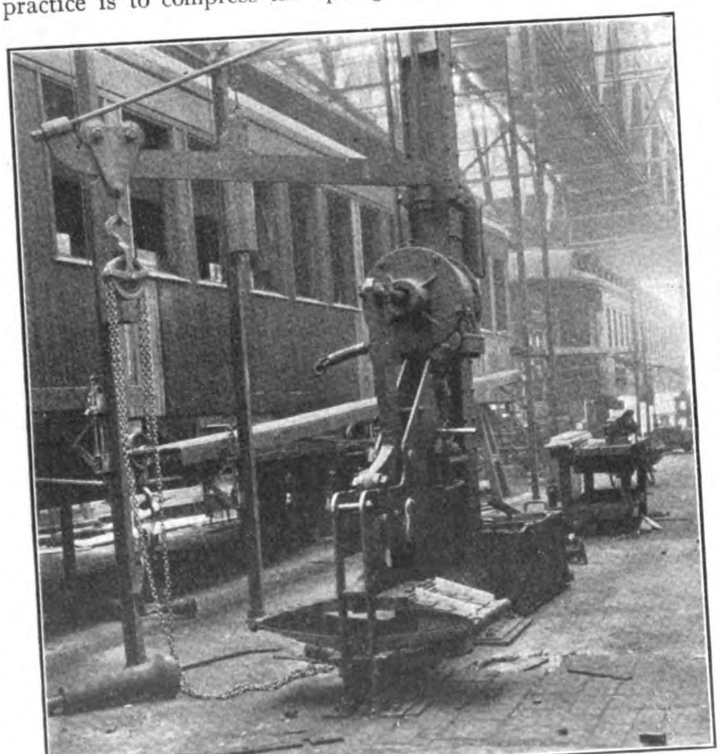
Responsibility for Car Damaged in Switching

On October 20, 1922, while switching over the hump track at Manheim, Ill., on the lines of the Chicago, Milwaukee & St. Paul, two cars containing scrap iron and in charge of a rider, were sent down on track 29 and came in contact with Chicago, Indianapolis & Louisville flat car No. 13324 loaded with stone, damaging the latter car. The handling line contended that the car was not subjected to any of the unfair usage conditions enumerated under Rule 32; that rider protection was furnished and that everything possible was done to prevent damage. It, therefore, reported the car to the owner for disposition under Rule 120. The car owner took the position that the car received unfair usage in that the speed of the cars which came in contact with the damaged car was excessive, and that the case should be handled under Rule 112.

The Arbitration Committee, in a decision rendered February 15, 1924, sustained the contention of the Chicago, Milwaukee & St. Paul and referred to the decision in case No. 1239 as being applicable to this case.—*Case No. 1312, Chicago, Milwaukee & St. Paul vs. Chicago, Indianapolis & Louisville.*

Machine for Clamping Elliptic Car Springs

One of the troublesome jobs in repairing passenger car trucks is the replacing of the elliptic springs between the truck bolster and the spring plank. The common practice is to compress the spring by means of a jack and



Air Operated Machine for Compressing Elliptic Springs for Clamping Before Applying Them to the Trucks

then clamp it in this position. This method requires considerable time and hard work. In order to perform this job with a minimum amount of time and labor, a machine has been developed at the North Billerica shops of the Boston & Maine for compressing the springs so that they can be readily clamped.

As shown in the illustration, the machine is fastened to one of the steel columns of the building. A 16-in. car brake cylinder furnishes the power which is transmitted to the spring by a bell-crank, the arms of which have a ratio of 3 to 1. The air is controlled by a two-way valve.

The springs are placed under the machine by a swinging jib crane to which is fastened a chain hoist. The spring is then compressed and clamped by two four-bolt clamps, one on each side of the spring bands. The spring is then taken from the machine and can now readily be placed between the truck bolster and spring plank. When replacing a set of elliptic springs on a truck, it is claimed that clamping the springs with the aid of this machine has reduced the working time by 30 min.

Links for Coupling Wreck Crane Cables

It is often necessary when clearing up wrecks to couple two cables together or to couple the end of a cable to a car. Figs. 1 and 2 show a coupler cable link and a cable link which are being used for such service. Both of these

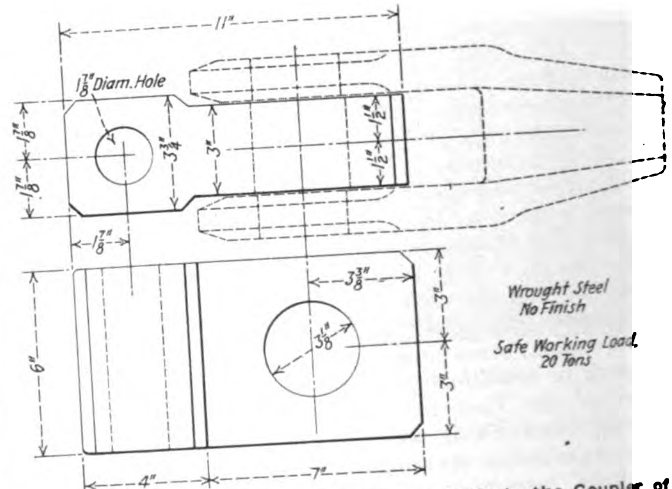


Fig. 1—Drawing of Link for Attaching a Cable to the Coupler of a Car

links are made of wrought steel and can be hammered out in the blacksmith shop. The coupler cable link is designed for a safe working load of 20 tons, and the cable link is

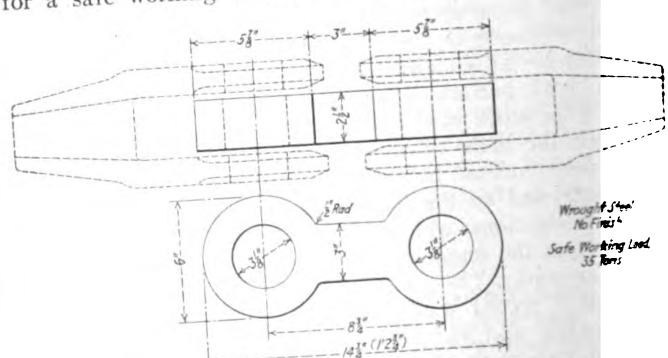


Fig. 2—Drawing of Link for Coupling Cables

designed for a safe working load of 35 tons. The method of securing these links to the cable sockets is shown in the drawings. The coupler cable link is secured to the coupler by removing the knuckle and holding the link in place with the knuckle pin.

The Prevention of Hot Boxes on Freight Cars*

Thorough Inspection, Analysis of Causes and Periodical Repacking Prevents Trouble

By E. Von Bergen
Air Brake and Lubricating Engineer, Illinois Central

THE problem of combating hot boxes on freight cars, is probably as old as the railroads. It is a problem that is of especial interest to the car foreman, in that he is the man who is held particularly responsible for their prevention and receives the largest measure of criticism for their occurrence.

In presenting this paper an attempt will be made to deal in a practical manner with the facts and conditions that confront us on the railroads today.

From the studies I have made while engaged in supervising the lubrication of locomotives and cars during the past few years, it seems to me that the pendulum of freight car lubrication swings from one extreme to the other. Years ago, economy in the use of oil was given no consideration whatever. In later years the oil companies made contracts with the railroad companies for furnishing the lubricants for their equipment, either on a gallonage basis, or a guaranteed mileage basis and seeing the terrific waste that was prevalent, agreed to furnish lubrication engineers who would instruct the men in proper practices. For many years it was dinned into the ears of the men how little oil was required to lubricate a journal, and it is a fact that it requires an astonishingly small amount. But the pendulum then swung to the other extreme and it would seem that many men who look after the lubrication of freight cars are under the impression that once the boxes are packed the car can run for years without any further attention. It is presumed that every freight car has the journal box packing removed and the boxes repacked approximately once every 12 months. If you have never done so, it would be very interesting to make a check of all the cars standing in any yard and observe from the packing stencilled record how much time has elapsed since the boxes were repacked.

In order to reduce to a minimum the hot boxes on any railroad, it is necessary to provide reports of such nature, that those in charge are advised from month to month as to the number of hot boxes developing on cars dispatched from each terminal.

Nearly every road issued a monthly report showing the number of car miles run per hot box on each division, but while this report shows any decrease or increase in the number of hot boxes in proportion to car miles made on each division, it does not provide information as to the performance of terminals. Neither does a report showing the number of hot boxes developing on cars forwarded from any particular terminal reflect the true situation. Therefore, to be properly informed, a report should be compiled at the close of each month which will show:

Name of terminal; number of cars forwarded; number of cars set out on account of hot boxes; number of hot boxes repacked by trainmen enroute and taken to next terminal; total hot boxes; number of cars forwarded per hot box. This report may be separated as between system and foreign cars if desired.

I have found this report, taken in connection with that showing miles run per hot box, invaluable in immediately reflecting terminals whose performance in prevention of hot boxes was not what it should be and requiring action to bring about an improvement.

Proper Repacking Important

The first essential in the prevention of hot boxes is, of course, to properly repack them after the packing has been removed for any reason. As to the proper method, opinions differ somewhat. All agree that a back roll, either made in the packing room or by the box packer, should be placed firmly in the back end of the box to exclude dust and retain oil. From there on, the process of packing may be divided between two general methods, one of which is to place one mass of packing under the journal extending half way up on either side and omit the use of the front plug. The other, is to place sections of packing under the journal extending half way up on either side, continuing this until the collar is reached, the last section to be tucked behind the collar presenting a perpendicular wall extending from the inner edge of the collar to the bottom of the box, then placing a wedge of packing between this wall and the front of the box, the top of this wedge, or plug, extending only one-half inch above the bottom of the collar and no threads of waste from this plug being permitted to interlace with those in the packing beneath the journal.

Of the two methods, I unhesitatingly recommend the latter, as I have tested out both and while with the former, the packing soon works out of position and requires frequent re-adjustment, I have seen the latter run hundreds and even thousands of miles without materially changing position.

In combating hot boxes on freight cars, there are but three different policies that can be pursued, viz.:

First—Oiling all boxes with free oil at terminal yards.

Second—Thorough inspection of the packing in all boxes at terminals and removing and re-adjusting the packing in all those found in improper position.

Third—Pulling and repacking all boxes on all cars while on repair tracks, regardless of the stencilled date showing previous repacking.

I shall not attempt to say which policy your road should pursue, but I will point out as briefly as possible, the scientific method by which you may arrive at a conclusion and it then remains for you to make your recommendations to your management as to which method you determine is the most efficient and economical.

Three Methods of Combating Hot Boxes

Oiling All Boxes With Free Oil At Terminals—This is the easiest and quickest method and entails the lowest labor cost, but it is the least effective, due to the fact that with packing improperly adjusted, surplus oil cannot and will not prevent all or even a very substantial number of hot boxes. It would prevent many that occur from dry packing.

Thorough inspection of the packing in all boxes at terminal yards and removing and re-adjusting the packing in all those found in improper position—Thorough inspection of the packing does not mean raising the lids and looking in the box. It means inserting a slender packing hook to the extreme back end of the box to determine whether the pack-

* A paper presented at the September meeting of the Car Foremen's Association of Chicago, and also at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association.

ing at the back end has settled away from the journal and in many cases before the hook can be thus inserted, packing has to be pulled out from the side of the journal as some one has filled it nearly to the brass, or it was improperly packed and crawled up. Re-adjusting the packing does not mean jabbing the packing in the front of the box with the packing knife, it means removing at least one-half the packing, pushing the remainder to the back end, then returning the removed half to proper position, as previously explained in the second method. To attempt to push the entire mass of packing back is worse than useless, as it merely jams the packing about half way back and makes bad matters worse. To ascertain in a few minutes whether inspection and readjustment in the terminal yards under your jurisdiction is being done as above described, calculate as follows: It is necessary to allot an average of two minutes per box and I may say in passing that every man on your force will have to hustle on this allotment. Take the average number of cars that pass through the terminal yard each 24 hours and multiply by eight which shows the number of boxes requiring attention; then multiply this figure by two and you have the number of minutes required. Now take the number of man-hours in each 24-hour period you have at your disposal for attending to journal boxes. Multiply these hours by 60, and the result should equal the minutes required. If any of you have a sufficient number of men engaged to meet the figures I have given above, or even half the number, I wish you would write me and tell me where the terminal is located, as I should like very much to visit it. Some of you are now thinking. "It is not necessary to test the packing with the hook, a competent man can tell when a box is properly packed by looking in it." To those of you who think this, I would say, "Stop fooling yourselves." If the packing has badly bulged in front, it, of course, indicates that it has "corkscrewed" out from under the back end of the journal, or was packed too full in the first place. If a dry spot appears on the end of the journal, it indicates it has been running above normal temperature. But, I have inspected hundreds of boxes and I have found scores which the inspectors or oilers pronounced all right, and to which I agreed looked to be properly packed, but when we inserted the hook to make sure, we found a hole below the journal at the back end of the box. Such a box is a potential hot box when it leaves a terminal. The packing may look right and may be right, but the only way to be certain that it is right is to test it with the hook. The chief objections to following the policy I have outlined is that the majority of cars do not stand still long enough in the yards so the work may be properly performed, and the labor cost is so high that it is practically prohibitive.

Repacking Boxes while on Repair Tracks, Regardless of the Date Previously Packed—In my opinion, unquestionably the most effective way for the railroads to reduce hot boxes on freight cars to a negligible quantity, would be to adopt a policy of pulling and repacking every journal box on their own cars every time they are on a repair track where a soaking vat is located, or where packing is shipped to and from a central reclaiming plant, and pull and repack foreign cars when stencilled record shows packing more than 12 months old, which would seldom be the case under this practice. My reason for this opinion is, that the packing would never become old and worn completely out as is so frequently the case at present. The greatest output could be obtained from the labor, as packers equipped with a barrow, packing tools and packing, can move along a string of cars on a repair track pulling the packing and return and repack, and do more work in one hour than the same man could do in three hours out in the terminal yard. Only a very few oilers would be required in yards, as with intensive attention on repair tracks, little attention other than the inspection, would be required in yards. The cost of material would be negligible as all the packing could be reclaimed. In order to determine what force is required on the repair track to follow this policy, the nearest basis to use for computation is 10 boxes per man per hour.

Hundreds of hot boxes occur on the railroads daily. In order to determine the cost of these hot boxes, add up the total amount expended on the system for rebrassing, replacing or turning cut journals, car delays, train delays, sending men out on line to rebrass or to apply wheels and divide the total hot boxes into the total amount of money. It will be found the cost will run close to an average of $12 per hot box.

If the amount expended thus for hot boxes is greater than the cost of employing a sufficient number of packers on repair tracks to repack all the boxes, then it is apparent to all that the employment of the additional packers will be an excellent investment.

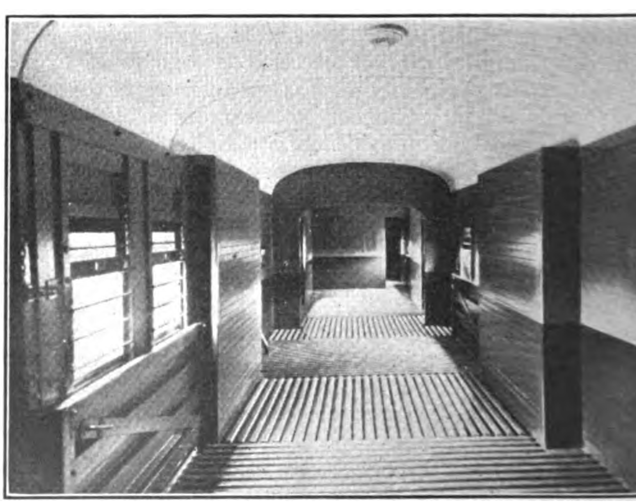
If the total cost of hot boxes as shown above is less than the cost of the labor required, then, obviously, additional investment in labor would be an unwise policy.

Use of Cooling Compounds

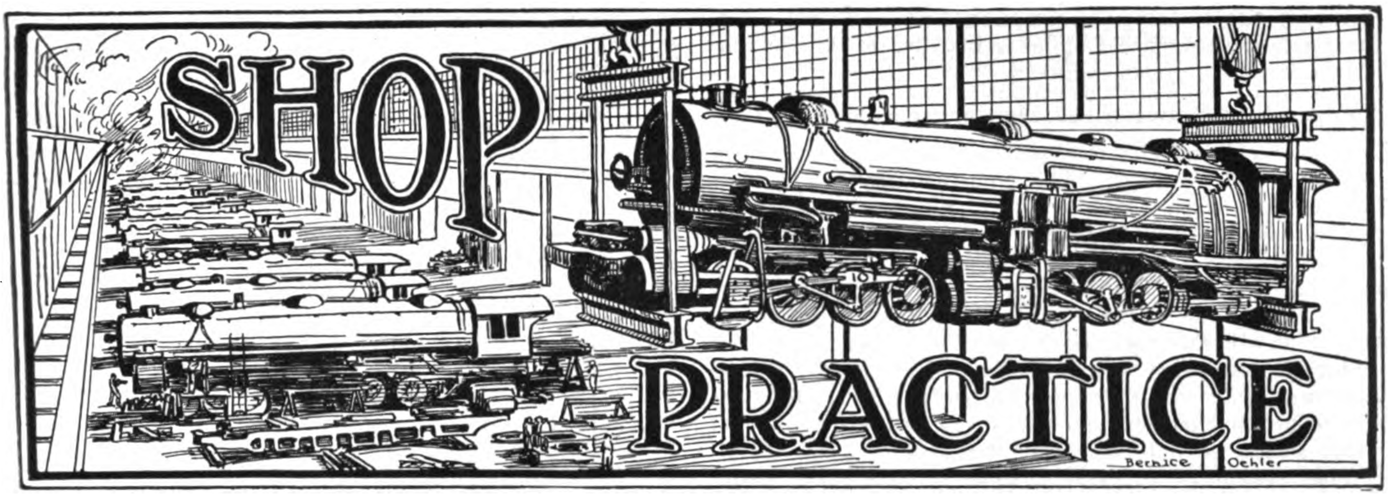
As an emergency measure for treating hot boxes that develop enroute, in order to bring them to a terminal where the hot bearings can be given necessary attention and repairs rather than setting them out on the road, I have found cooling compounds very effective. While we all know that any hot box is expensive, the hot box that entails setting out the car is vastly more expensive than the one that permits the car to move to a terminal where car repair forces are engaged.

On a large number of tests with which I am familiar, 95 per cent of the hot boxes that developed were taken through to the terminal after being treated with a cooling compound, and on a large system, three months after the use of a cooling compound was generally begun, the number of cars set out per month on account of hot boxes was reduced more than 50 per cent.

We cannot eat our cake and have it too. We cannot provide the car foreman with an arbitrary number of men and expect him to eliminate hot boxes entirely, regardless of the fact he has double or treble the number of boxes requiring attention than are humanly possible for his force properly to cover. The problem requires scientific analysis and then sufficient men to meet the situation if we are to suppress the age-old aggravation of the hot box.



Interior of Baggage Car Built for the Central Argentine Railway, Ltd., by the Gloucester Railway Carriage & Wagon Co., Ltd., London, Eng.



Reducing the Cost of Locomotive Repairs

A Discussion of the Application of Modern Production Methods in Locomotive Repair Shops

By William S. Cozad
Shop Supervisor, Lehigh Valley, Packerton, Pa.

THE successful operation of railway repair shops, as well as private industrial concerns, demands occasional changes to meet new conditions and new requirements. Old conditions become obsolete. They are too slow and too expensive. Established purposes change. New demands arise and events take unexpected twists and turns.

General repairs to the same number of locomotives and cars each year are not sufficient to meet expanding business and corresponding increases in the volume of equipment. To take care of this additional equipment adequately and efficiently, either present shop output must be largely augmented, or new shops or additions to old shops must be built.

To enlarge old shops or build new shops involves the expenditure of large sums of money, and when completed, these betterments and improvements, through depreciation and taxes, become an immediate permanent source of expense.

Where there appears to be ample room to increase the output, the possibilities of a more intensive use of present shop buildings and a reasonable expenditure for improved machinery and small tools, increase in competent help and the introduction of improved shop engineering as well as accounting methods, would seem to be a proper subject for investigation.

The character and qualifications of the management of any plant is of primary importance in its successful operation. To work a locomotive at its highest point of efficiency requires a skilled engineman and a good fireman. To secure the greatest possible plant output at the lowest cost requires that each factor of shop organization be highly capable of pushing forward its part of the business.

Successful shop management is not the job of the plant superintendent or of the general foreman only. It is the job of every supervisor in the plant. Each foreman, each gang boss, and each lead man must have a common desire to render exacting service and to contribute his full share to the efficiency of the entire plant.

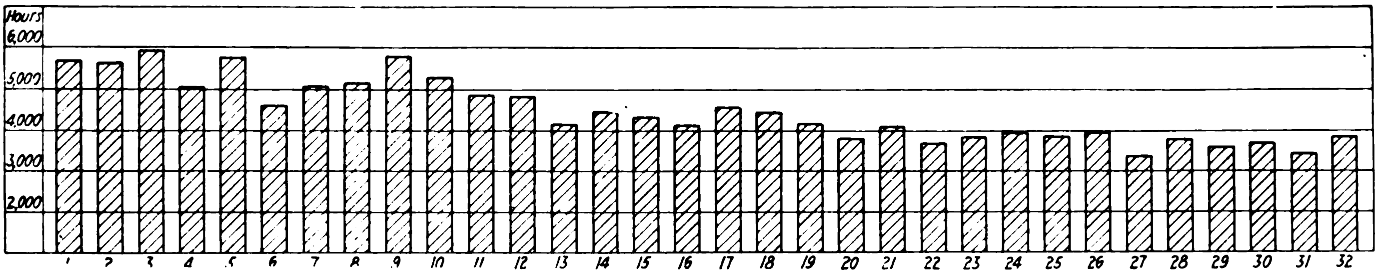


Chart Showing the Reduction in Hours Charged Against 32 Prairie (2-6-2) Type Locomotives for Boiler Repairs—These Locomotives Received New Fire-Boxes and Had General Repairs Made to Machinery

Weekly meetings of the supervising force are a necessity. They immediately inform the heads of the departments of requirements in connection with their part of the work on equipment in the process of repairs. They give each foreman and gang boss an equal opportunity to state his views in reference to any lost motion that may exist and to suggest methods to overcome it. The progress of the work on every locomotive in the shop for repairs may be discussed. Material supplies, tools, prevention of accidents, new methods of doing the work, reclamation of material, grievances, and the best methods of increasing production should be topics for discussion at these meetings. Such conferences place the

man prominently before his associates, who does not measure up to the standard and he is impelled to do better or step aside for the man who can.

Co-operation Between the Men and the Management

It has been contended that workmen are only concerned in making the day's wage. This unnecessarily narrow view has, to some extent, resulted in branding shop efficiency methods in hourly rate plants as impracticable, and the additional claim that production can only be increased by the use of some time-measuring device. The stop watch, however, in the opinion of the writer, has done more to antagonize labor than all other agencies that have been used in the past century in connection with cost reduction processes. A time study man that cannot secure sufficiently accurate time for cost reduction purposes on repair operations without a stop watch should go into some other business.

This system of production which is based on sound economic principles commands the respect of all grades of workmen. It places an agreeable responsibility on each department foreman. While eliminating the piece-rate, premium or bonus features, it still places the workman under a moral obligation to perform a reasonable amount of work in a limited time. The workman was consulted in setting the time and he thus became a party to the contract. It is then up to him to fulfill an agreement which is neither more nor less than faithfully to execute the work assigned him.

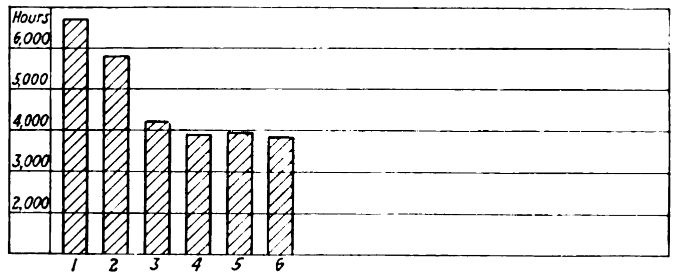
Directing labor in railroad shops is an important business problem. But the feature of most importance is the development of a fair, constructive attitude of mind on the part of the workman.

The natural tendency and purpose of every honest man is, not simply to do well his appointed duty, but also, to defend his employer against loss. This is almost an axiom and all employees should be considered as honest, energetic and a necessary part of the organization to secure the most efficient results.

High wages will not make men loyal. High wages will not increase production. High wages will not solve the labor problem. The fact is, wages have little to do with loyalty. Labor unrest is not the result of either low or high wages, but is due, primarily, to propaganda spread by outside agencies. Poor working conditions and unfair treatment may also add to dissatisfaction. With this existing condition admitted, one of the most important duties of every officer and every loyal worker in the service of the railroads is to employ the necessary means to counteract these evil influences. To attain this end, much personal work among the masses is always a paying investment. The personnel or welfare work, however, that counts the most, both for the company and the employee, is sanitary and comfortable shop conditions, good tools, providing the necessary facilities for producing effective results, and also the recognition of honest effort—giving a square deal.

Occasional efforts at personnel work in flush times will not build up confidence among the workers. Constant attention must be given to such matters, thus establishing a constructive tradition of fair dealing that industrial reverses or outside influences cannot tear down.

Grievances of one kind or another arise at some time in every business concern. Most of them are petty in character. If the employee has no established way to air his troubles, he will talk to his fellow workers about them until they grow to be matters of tremendous importance in his own mind. A man with a grievance is going to talk about it under any and all circumstances. It is a wise management



Reduction in the Number of Hours Charged Against Six Mikado Type Locomotives for Stripping and Assembling

that makes it easy for him to do this talking where he will get a satisfactory hearing and good advice in return.

The Application of Efficient Methods

Workmen should be tested as to qualifications for the job, classified as to ability and advanced year by year into higher grades on a basis of length of service or demonstrated fitness. Men are no more alike in their capacity to do useful work than in temperament or intelligence, therefore, a flat rate for all mechanics of a specified profession is unfair and unreasonable. No man should be employed or dismissed from the service except for just cause. Reduction in hours, force or pay should be made in accordance with well understood regulations into which personality does not enter. Strict adherence to these principles will do much to eliminate labor troubles and labor disputes.

One of the direct aims of every successful shop must be to keep good employees in the service and to dispense with those that fall below a reasonable standard of efficiency. The longer an employee remains in the same shops, whether in a lowly or important position, the more he should come to know about the purposes, the conditions and the needs of that shop and the more valuable he should be to it. Frequent changes of employees mean corresponding decreases in profits.

Stability of employment can only be preserved in shops where men are contented, where discipline is rigid but just, where men are placed on work for which they are suited, where no partiality is shown, where the foreman puts himself in the other fellow's place before administering discipline, where appreciation is shown for extra good work in quick time, where special ability is rewarded whenever

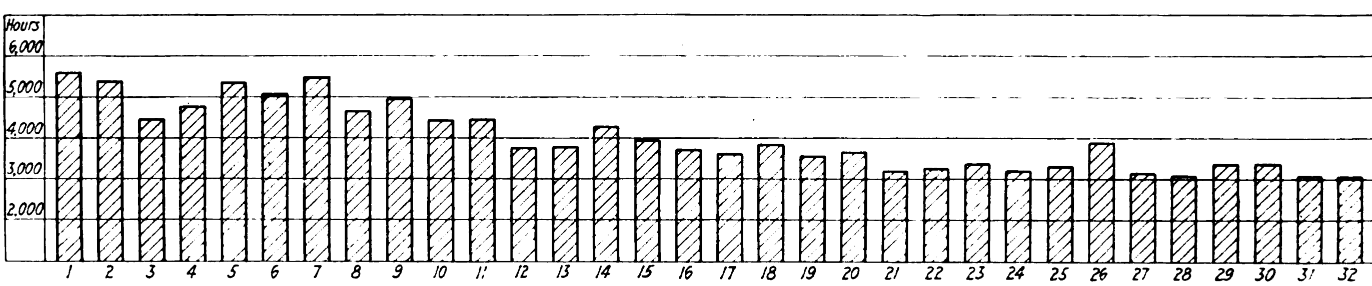


Chart Showing the Reduction of Time Obtained in the Work of Stripping and Assembling on 32 Prairie Type Locomotives

possible, where only promises are made that can be fulfilled, where material is furnished promptly and where safe and sufficient tools are furnished to do the work. Working along these lines, relations will be established with employees on the basis of facts, fair play and faith in each other.

Here is where systematic methods of management must prevail. System is not work but a means of reducing the amount of labor necessary to produce a fixed product. System requires no specialist but permits a few to accomplish much by bringing all hands into intelligent action. System loads no man with labor beyond his proper share but lightens the task of each workman by exactly defining it.

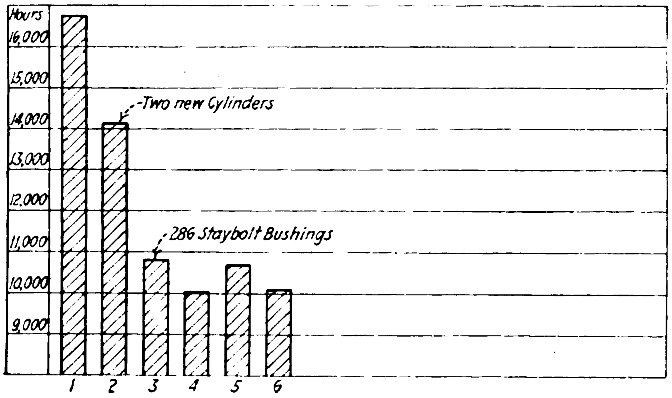


Chart Showing the Reduction in Hours for Applying New Fire-Boxes and Making General Boiler Repairs to Six Mikado (2-8-2) Type Locomotives

The heavy load usually borne by a few faithful employees is distributed evenly upon all. Hard work always begins where system and the application of intelligent methods end.

The Problem of Increasing Shop Production

During the past two years the subject of increased shop production has been up for frequent discussion and there seems to be quite a strong sentiment in favor of adopting means and methods that will place workmen on their honor rather than to subject them to some rigid form of task system.

Briefly stated, this new method consists in separating the repairs on a locomotive into certain well defined parts and, after inspection and decision by authorized parties as to the work to be done on each subdivision, a time limit is set in which to do the work. Gang bosses and workmen then unite in a combined effort to accomplish the work in the time set for the job.

Cost Reduction Methods in a Privately Operated Plant

During the past year the writer had ample opportunity to observe the merits of this system. In many instances it was found to be somewhat loosely applied. It has, however, affected the cost of repairs on a large number of railroads.

The cost reduction methods described in the following paragraphs of this article have not been evolved from any theoretical conception as to what might be accomplished under certain assumed circumstances. They are based on results obtained under actual working conditions, in the modern equipped plant of the Minneapolis Steel and Machinery Company, Minneapolis, Minn., which is privately operated. This is one of the largest manufacturers of structural steel and agricultural machinery in the northwest, and is also thoroughly equipped to do heavy locomotive repair work on a large scale. The records from which data has been taken includes heavy repairs to more than 150 locomotives. One large building in this plant was equipped with pits and utilized as an assembly and erecting shop. The contract was based on a flat rate per hour for all classes of productive labor. The railroad companies were represented in the plant by the usual number of boiler and machinery inspectors who had direct authority only over the amount of repairs to be made and the quality of the workmanship. The large reduction in hours was the result of excellent co-operation between the company officers and the railroad inspectors. A time was set for each division of the repairs as nearly correct as was possible under the circumstances. Efforts were made on the part of the representatives of the railroad to convince the department foremen, and through them, the men, that the repairs outlined could be made in the time set for each classified operation.

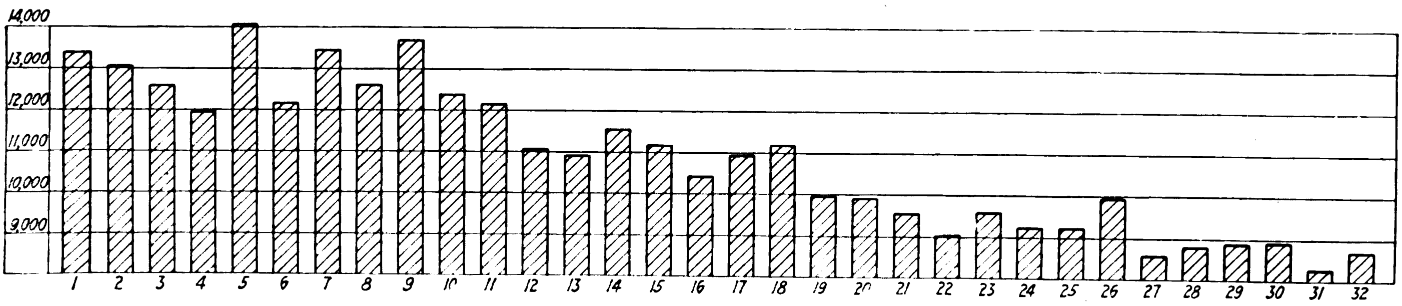
The mark was frequently missed as the aim was not always accurate. The time estimates were based largely on guesswork. There was no master schedule and no time study of scheduled operations had previously been made. The results obtained, however, demonstrated conclusively that a surprisingly large reduction in cost resulted when correct methods were carefully worked out and applied.

Two subdivisions of the classified schedule used in connection with this work are outlined in the next paragraph. In making such a schedule, each sub-division should be carefully detailed and explained, and the work to be done in each department outlined so that a reasonable time estimate is assured.

Stripping the Engine

The work of stripping the engine complete, includes the removing of the main and parallel rods, the driver brake and spring rigging, the wheels, the engine and trailer trucks, shoes and wedges, the ash pan and grates, stoker rigging, the front end and netting arrangement, the steam and dry pipes, the headlight and classification lamps, cab, running boards and pilot, guides, crossheads and pistons and all motion work which includes the valves and valve gear, eccentrics and straps, reverse lever, reach rod, lift shaft and boxes, bell and bell ringer, turbine, jacket and lagging, air pump, air reservoirs, all of the expansion gear, frame braces, tail bars, deck and filling castings.

This list should also include cutting the boiler loose from the frame and delivering it to the boiler shop for a new fire-box and for any other repairs that are required. The total time to be allowed for this work is determined



Reduction in Total Time for 32 Prairie Type Locomotives Receiving New Fire-Boxes and Having General Repairs Made to Machinery

from the summation of the time allowances charged to each of the detailed operations shown in Table I. This list shows the various subdivisions of the entire stripping operation and each item should be given a reasonable time in which to perform the operation.

Table I—Time Allowances for the Detailed Operations in Stripping Engines

Reference number	Description of operation	Time allowance
	Ashpan and grates	
	Air pump	
	Blow-off cock and rigging	
	Boiler cut loose from frame and cylinders and delivered to boiler shop	
	Brake rigging	
	Cab removed and located ready for repairs	
	Cylinder heads and casings:	
	Front head and casing	
	Back head and casing	
	Cylinder cocks and rigging	
	Driving wheels, pedestal braces, shoes and wedges	
	Deck casting	
	Dome casing and cap	
	Engine truck	
	Eccentric rods and straps	
	Eccentrics	
	Engine bell and bell ringer	
	Expansion plates	
	Front end door and netting arrangement	
	Frame cross braces	
	Frame filling castings	
	Guides and crossheads	
	Lift shaft and boxes	
	Lagging	
	Links, link hangers and transmission bars	
	Pilot	
	Pilot draw-bar	
	Pilot bumper beam	
	Pipes, all air, steam, oil and water	
	Pistons cut loose from crossheads	
	Pops removed	
	Rods, main and parallel	
	Running boards	
	Rocker arms and boxes	
	Reverse lever and reach rod	
	Spring rigging	
	Stoker rigging and fire door arrangement	
	Steam and dry pipes, throttle rigging	
	Smoke box braces	
	Sand box and casing	
	Trailer truck	
	Turbine	
	Tail bar arrangement	
	Valve chamber heads and casings	
	Valves and valve rods	
	Whistle and whistle rigging	
	Miscellaneous small parts	

Instructions: Total time should be charged when all items are removed. Allowances should be made in cases where all items are not removed. The removal of cylinders, frames, deck castings, tail bars, fire boxes, expansion gear, frame cross braces and similar parts should be charged as separate time to be allowed after all work has been completed.

Fire-Box Repair Work

Under this heading should be included all of the following work: burning off the back head and mud ring rivets, burning out all staybolts and crown bolts, ripping the throat sheet, side sheets, back door sheet and removing the crown sheet, removing the back head and mud ring, fire door, frame and arch tubes.

Building and Applying a New Fire-Box.—This includes laying out all the sheets, flanging, shearing, punching, drilling, rolling and shaping; all chipping and countersinking; bolting the sheets in place; heating and lying up all laps and corners, laying out, shearing, welding and applying the door sleeve, bolting all parts together and getting the fire-box ready to drive rivets. Any work necessary to complete this operation that is not specified is included in the estimated time.

Completing the Fire-Box.—This includes chipping and calking all rivets and seams; locating the box on the boiler, applying and riveting the back head; applying the mud ring, tapping out holes; applying and driving all corner plugs; chipping and calking the corners; calking the mud ring and back head seams; riveting the door collar to the back head and chipping and calking. Getting the fire-box ready for the boiler braces, staybolts and crown bolts.

Staybolts and Crown Bolts Applied.—This includes bushing or welding all oversize holes in the outside sheets; drilling and reaming to size; tapping all the holes; preparing for flexible staybolts; renewing the sleeves or making a complete new installation as required. Screwing in staybolts, setting to length, cutting off, driving both ends and opening up the tell-tale holes. Any preparatory work necessary on the edges of the outside sheets and any other details not specified here should be included in the estimated time.

The fire door and attachments are removed, overhauled or replaced. This includes all work in all departments necessary to complete the job.

Study Should Be Extended to Other Jobs

A similar study should also be made for each of the following jobs. This list does not include such items as the booster, automatic train control locomotive equipment, stoker and various other appliances with which many shops have to contend.

1—Barrel of boiler
2—Washout plugs
3—Ashpan and grates
4—Flues
5—Superheater units
6—Front end arrangement
7—Steam and dry pipes.
8—Tender, cistern
9—Tender, frame
10—Tender, trucks
11—Engine truck
12—Trailer truck
13—Driver brake rigging
14—Driving spring rigging
15—Crossheads and pistons
16—Guides
17—Motion work
18—Main and parallel rods
19—Frames
20—Cylinders
21—Driving boxes
22—Shoes and wedges
23—Air pump and air-brake equipment
24—Electrical work, headlight and classification lamps
25—Pipe work
26—Cab work
27—Running boards
28—Pilot
29—Cab fittings
30—Boiler fittings
31—Boiler studs
32—Jacket
33—Lagging
34—Driving wheels
35—Wheeling locomotive
36—Painting locomotive and tender
37—Testing locomotive, hydraulic test
38—Testing locomotive, steam test

Installation of a Cost System

The installation of any cost reduction system presupposes some specific gain to be obtained by its adoption. The primary objects in this case were:

1—A reduction of man-hours in the general repair of cars and locomotives.
2—Harmonious co-operation of shop supervision and employees.
3—Comparative cost of similar work, as between shops.
4—Comparative cost of maintaining similar parts on different classes of engines.
5—A correct charge for labor to the work on which it is employed.
6—A proper distribution of all overhead and non-production expenses.
7—A shop order system that would successfully follow all orders for finished or semi-finished parts from receipt of order to delivery of the finished product to the store room. This includes the accumulation of workmen's time and shop expense in proper form for stores and accounting departments.
8—A simple and inexpensive method of recording used material and showing proper credit for scrap. Overhead expenses up to the point where summaries are turned over to the accounting department for final distribution.
9—A record of facts and conditions maintained so that a quick analysis may have an immediate effect on future work of similar nature.

The methods of accounting for shop orders, material, records of employees' time, etc., should be applied in such a manner as to furnish the accounting department all the information needed to comply with Federal requirements. But, it is believed the shop organization should have jurisdiction up to the point where this information is summarized.

Whatever cost accounting is necessary may be obtained by introducing into the shops a system of engineering accounting. This consists of the formulating and the carrying on of a cost keeping system which embraces the essentials necessary properly to analyze current performance in the shop. This means, not only keeping a record of costs, but using this data to reduce costs. The assistance of the

accounting department, as to methods and requirements, should be obtained in this work.

TABLE II—TIME ALLOWANCE FOR THE DETAILED OPERATIONS IN RENEWING FIREBOXES

Reference number	Description of Operation	Time allowance
	Burning off the rivets in the mud ring, back head and fire door sleeve	
	Burning all the staybolts and crown bolts loose from the outside sheets	
	Ripping the fire-box sheets into sections for convenient size to be removed	
	Driving out the back head and mud ring rivets, removing the mud ring corner plugs, removing the back head and the ring and delivering with the old fire-box sheet sections...	
	Allow for any work not covered above	
	Outside sheets, edges or flanges built up by electric welding and chipped to original size.....................	
	Flanging back flue sheet	
	Flanging throat sheet	
	Flanging door sheet	
	Laying out all sheets	
	Shearing and punching all sheets........................	
	Rolling and shaping all sheets........................	
	Beveling and preparing the edges of all sheets............	
	Drilling and countersinking	
	Setting up the fire-box and bolting together ready for riveting, laying up all corners and seams.....................	
	Applying and riveting the door sleeve..................	
	Fire-box riveted ready to chip and calk, ...	
	Fire-box seams and all rivets chipped and calked........	
	Locating the fire-box on the boiler....................	
	Applying the back head bolting and driving rivets........	
	Scaling the mud ring and building up the worn places by electric welding and chipping....................	
	Applying the mud ring and bolting preparatory to reaming holes	
	Heating and laying up the mud ring corners...........	
	Driving all mud ring rivets........................	
	Applying all mud ring corner plugs.....................	
	Chipping and calking the mud-ring seams and rivets....	
	Chipping and calking the back head rivets and seams......	
	Heating and laying up the door sleeve ready to drive rivets	
	Riveting the door sleeve	
	Chipping and calking the door sleeve rivets and seams	
	Applying arch flues	
	Allowance for handling of scaffolding, changing tools and any other miscellaneous items not covered............	

Close relationship between responsibility and cost is the active agency required to improve operation. Methods and accounts beyond that which are necessary to provide data for effective control are not justified but exact cost of operation, whatever it may be, is worth the expense to obtain it. The value of shop records, and of time records particularly, depend entirely on the accuracy of their elements and this demands the proper segregation of charges.

Time-keepers must be active, energetic, intelligent workers, accurate in their calculations and exact in specifying on the

Daily record of hours charged against________								
Schedule Numbers and Description of Work								
	No. 19 Motion Work		No. 28 Cab Work		No. 35 Lagging		No. etc.	
	Total hrs. 200		Total hrs. 75		Total hrs. 20		Total hrs.	
Date	Hrs. used	Hrs. left	Hrs. used	Hrs. left	Hrs. used	Hrs. left	Hrs. used	Hrs. left
3/6	15	185						
9			13	62				
13	4	181	6	56	5	15		

Form on Which the Daily Time Charges Against Each Operation Are Summarized

daily time-card the proper charge, as well as the time and the nature of the work performed by each man.

Workmen, as a general rule, should not be required to make out the daily time-card. Usually, through lack of experience or improper training, they are not qualified to distribute their time correctly. This should not apply to apprentices.

Material orders ought only to be issued by one or more trained men who know the value and the necessity for the parts on order. This will insure a proper distribution as well as give an intelligent check on disbursements.

The overhead should be distributed, as far as possible, by departments, a separate shop expense account being kept for each distinct section of the shop. This should cover supervision, repairs to machinery, heat, light, etc. Effective control is insured by definitely fixing the indirect expense along departmental lines, which establishes individual responsibility and furnishes the department executive a means of analyzing his costs.

Intimately related to this cost reduction system will be the matter of wages and working conditions. Regardless of all cost accounting methods, the cost of performing any one unit of work can never be controlled until it can be predetermined what the wages will be for performing that

PROGRESS REPORT

General Repairs to Locomotives

Name________ Department________ Date________

Please see time allowance and time used to date, operations listed below:

Charge	Schedule number	Description of work	Time Allowance	Time Used	Remarks

____
Supervisor Shop Costs

Form for Recording the Progress of Work on Individual Operations

particular operation. To secure this information and to establish master schedules, which must form a standard basis for all comparisons or estimates, time studies are necessary. The systematic study of methods, conditions, and the determination of a reasonable time in which to do the work has a merit which no mechanical or other means can imitate. The capable, energetic, square-deal man engaged in this occupation, if he is a good mixer and practical observer, has a wonderful opportunity to study efficiency of operation. He will smooth out many of the workmen's petty grievances as well as devise ways of improving methods, handling the work, controlling working conditions and many other details which will improve the service. If the investigator has analytical ability and has instinct for the right way to work, he will be able to suggest many improvements in methods and time which will be acceptable to his fellow workmen. He can carry on this work in such a way that the workmen will feel that they have formed a prominent part in the development of the economic changes in time, tools and methods.

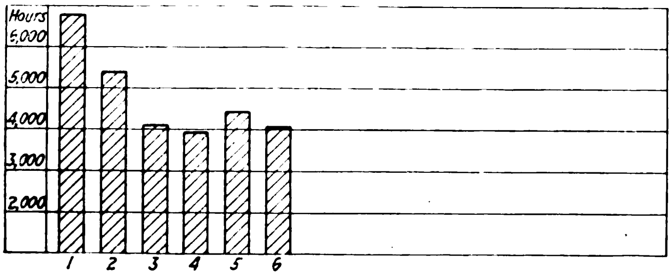
Organization for a Cost Reduction System

The organization necessary to install and operate the foregoing cost reduction system is inexpensive when compared to the savings obtained. It is recommended that the additional local shop organizations engaged in doing extensive heavy repair work be constituted as follows; one supervisor of shop costs, one inspector and estimator, two time study men, two shop time-keepers, one shop accountant, one stenographer and typewriter.

A general supervisor of shop costs should be required to assume responsibility for the introduction of production methods into all repair shops on the railroad adopting the system. He should report directly to the head of the mechanical department and have general supervision of all cost reduction processes in all shops. The local supervisors should report jointly to the general supervisor and the shop superintendent or the master mechanic. The inspector and estimator is subject to double duty as the title indicates. He should inspect jointly, with the department foreman, all parts to be repaired and make a record of the work

to be done, and with the assistance of the supervisor of shop costs, estimate the time required to perform the work, according to scheduled operations and see that each gang boss is advised as to the time allowance and also furnish a detailed statement of the time spent the previous day and the time yet remaining in which to complete the work.

Time estimating should not be made effective until the shop forces are sufficiently acquainted with the schedule and the system in general. The duties of the time study men, time-keepers, shop accountants and stenographers are well known and need not be discussed here. Time study men should not be employed until the new methods have had sufficient trial to determine what changes, if any, are necessary to secure satisfactory results.

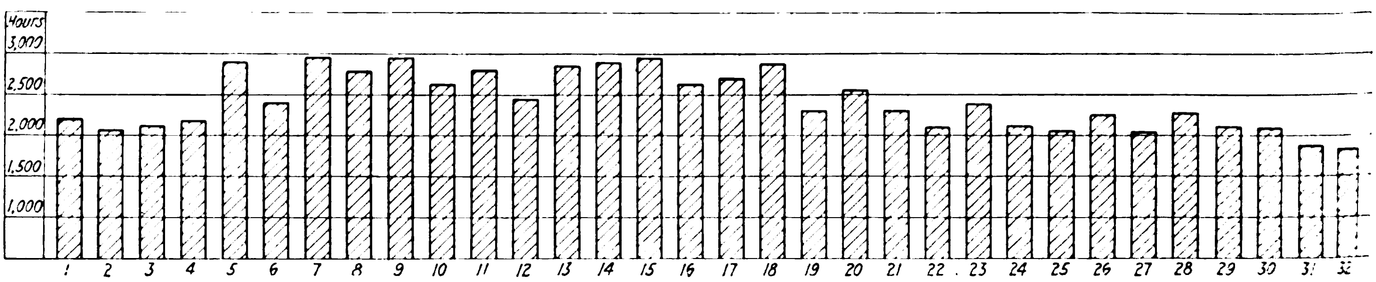


Graphic Record of the Reduction in Hours Charged Against Six Mikado Type Locomotives for Boiler Repairs

TABLE III—A SUMMARY OF THE RESULTS ACCOMPLISHED UNDER THE PRODUCTION SYSTEM

Prairie type locomotives	
Total number of hours charged against the locomotives in period number one,	129,007
Average number of hours per locomotive	12,901
Total number of hours charged against the locomotives in period number two,	217,519
Average number of hours per locomotive,	10,358
Total reduction in hours on 22 locomotives receiving new fire-boxes and other heavy boiler repairs and also heavy repairs to machinery, under the system of determining costs in period number two as against period number one when no fixed system was in use	53,403
Mikado type locomotives	
Total number hours charged against the locomotives in period number one,	30,861
Average number of hours per locomotive	15,430
Total number of hours charged against the locomotives in period number two,	41,641
Average number of hours per locomotive	10,410
Total reduction in hours on four locomotives	20,080
Total reduction in hours, on both classes of locomotives of period number two over period number one:	
Prairie type	53,403
Mikado type	28,080
Total reduction in hours accomplished in eight months	73,483
Total per cent reduction on all classes of repairs	20 per cent

The comparative data and charts in this article have been taken directly from the records of the Minneapolis Steel & Machinery Co. They illustrate in a forcible way the excellent results obtained by this company through the use of systematic methods in locomotive repairs.



Graphic Record of the Number of Hours Required for the Machine, Blacksmith, Welding and Cutting, Carpenter and Painting Work on 32 Prairie Type Locomotives

Records were first kept to determine how many hours the different departments of the shop were being charged for each detailed operation. This initial study enabled the department heads to have an individual performance record by which the merits of the new production system could be judged. It might be well to state that while the tables and charts refer particularly to locomotives getting new fire-boxes and other heavy repairs to machinery, other locomotives were going through the shop for class three and five repairs.

The first locomotive of the series recorded in the data given here was put into the shop October 2, 1922. The last engine was turned out June 12, 1924. There was a total of 117 locomotives of which a more or less definite account was kept. Forty-two of this number received new fire-boxes and heavy repairs to machinery. The first locomotive with a new fire-box was turned out May 9, 1923. Other locomotives of which no production record was kept, went through the shop prior to the time the company began turning out fire-boxes. No appreciable reduction in the number of hours resulted, however, until complete daily records were compiled which showed the number of hours charged against these operations by departments for each day. The gang foremen

TABLE IV—ESTIMATED AND ACTUAL TIME ON TWO LOCOMOTIVES OF THE SAME CLASS, RECEIVING NEW FIRE-BOXES, AND THE SAME GENERAL REPAIRS

In column number one, the locomotive was out of the shop October 26, 1923. Column number two, gives data for a locomotive that came out of shop four months later on February 26, 1924. Note the progress made in the actual time reduction in four months time.

		No. 1		No. 2	
No. of Operation	Description	Estimated time, hours	Actual time, hours	Estimated time, hours	Actual time, hours
1	Stripping	220	282	175	142
2	Fire-box	1600	2389	1350	1605
3	Boiler barrel	725	789	450	484
4	Staybolts	1000	917	850	818
5	Crown bolts	450	600	450	360
6	Boiler braces	130	253	250	324
7	Wash-out plugs	50	213	75	62
8	Flues, ash pan and grates	350	375	345	418
9	Front end	100	154	100	158
10	Tender, frame and trucks	470	698	580	443
11	Driving boxes	160	197	140	105
12	Engine and trailer trucks	160	192	190	203
13	Spring and brake rigging	420	435	380	289
14	Guides	100	75	75	80
15	Motion work	460	606	435	394
16	Crossheads and pistons	200	168	170	130
17	Rods	180	280	180	182
18	Frames	250	396	300	370
19	Cylinders	240	276	160	166
20	Steam pipes	120	259	150	157
21	Shoes and wedges	90	84	65	75
22	Wheeling	80	106	90	55
23	Air pump	40	80	50	68
24	Airbrake equipment	100	93	100	84
25	Turbine, headlight, electrical work	54	55	45	46
26	Pipe work	250	301	250	249
27	Cab. running boards, pilot	170	300	225	233
28	Cab fittings	110	96	100	83
29	Boiler fittings	90	277	150	241
30	Boiler studs	140	148	125	159
31	Jacket, lagging	200	276	185	238
32	Driving wheels	170	173	170	136
33	Painting	130	217	150	206
34	Welding and cutting	225	722	375	498
35	Testing engine	100	196	80	128
	Total hours	9,334	12,578	8,965	9,289

and lead men were advised each day as to the number of hours spent and the number of hours remaining to be spent before the completion of each job.

This arrangement was made effective about September 1, 1923, and for purposes of comparison the data for locomotives receiving fire-boxes and other heavy boiler and machinery repairs, shown in the following summarized tables, has been divided into two periods. Period number one is for locomotives receiving new fire-boxes turned out prior to October 1, 1923, and period number two is for locomotives receiving new fire-boxes turned out subsequent to that date. This class of repairs was selected for comparing cost data on work of a similar nature as to the amount and kind of labor required.

Locomotive Repair Costs

The following items show, in a brief way, the amount of work done on the eleventh and twelfth locomotives that went through the shop after the production system had been installed. This list contains substantially all the information the company had at hand on which to base estimates, as no master schedule was available. These items are representative of the repairs made on all of the locomotives referred to in this article.

THE WORK REQUIRED ON THE ELEVENTH AND TWELFTH LOCOMOTIVES THROUGH THE SHOP

No. 11	No. 12
New fire-box	New fire-box
New front boiler course	New front boiler course
New front flue sheet	New front flue sheet
New installation Tate bolts	Turn tires
Turn tires	Turn all journals
Two new hub liners	Bore both cylinders
Turn all crank pins	Two new piston heads
Turn all journals	One new piston rod
One new side rod	New trailer axle
Bore both cylinders	Two new trailer hub liners
Two new piston rods	Turn two eccentric cams
Grind piston rods	Four new valve bushings
Three new trailed hub liners	New front waist sheet angle
One new eccentric cam	
Bore valve chambers	
Grind valve stems	
One new driving box	
New air pump bracket	

The writer does not contend that these records can be duplicated in modernly equipped railway repair shops where repairing locomotives is an established business and where men, skilled in their respective lines of work are employed. However, with the introduction of specific methods of systematizing the work as outlined in the subdivisions of the foregoing schedule, supplemented by a knowledge of what men can do and of the average time required to perform each part of the work, a 15 per cent reduction in hours could be effected.

As an illustration of what may be accomplished, let us assume a locomotive repair shop having a capacity of 300 general repair locomotives per year. Of this number, we will also assume that 50 engines will get new fire-boxes, leaving 250 locomotives to get class three or five repairs.

The average number of man-hours charged against locomotives getting a general overhauling in a shop such as is assumed above under ordinary working conditions would be about as follows:

Class two repairs,/	7,000 man-hours
Class three or five repairs, ...	3,500 man-hours

Therefore, 50 locomotives at 7,000 man-hours per locomotive would equal 350,000 man-hours, and 250 locomotives at 3,500 man-hours each would equal 875,000 man-hours, giving a total of 1,225,000 man-hours. A 15 per cent decrease by the introduction of systematic methods of estimating time on scheduled operations and intensive checking to see that the work is completed within set time limits, would result in a saving of 183,750 man-hours. The gross saving to the railroad company at an average day rate of 60 cents per hour, would be $100,250, and the expense of the total additional organization necessary to promote this work should not exceed $15,000 giving a net profit of $85,250.

It is not claimed that the scheme outlined in the preceding paragraphs will work any particular wonders in cost reduction, but it will meet at once the hearty approval of all classes of supervision and labor. It will bring to light expensive processes, develop weak spots and lay a permanent foundation for future scientific and economical development in railroad shop production.

TABLE V—DIVISION OF TIME BY DEPARTMENTS CHARGED AGAINST LOCOMOTIVES RECEIVING NEW FIRE-BOXES AND GENERAL REPAIRS TO MACHINERY. OUT OF SHOP, MARCH 28, 1924

No. of operation	Description	Erecting shop hours	Boiler shop hours	Machine shop hours	Vise shop hours	Blacksmith shop hours	Total hours
1	Stripping	151	...	...	...	...	151
2	Fire-box	...	1,257	8	...	1	1,266
3	Boiler barrel	...	102	...	...	2	104
4	Staybolts	...	708	4	...	...	712
5	Crown bolts	...	397	...	...	15	412
6	Boiler braces	...	140	...	...	40	180
7	Wash-out plugs	...	61	25	...	...	86
8	Flues	...	287	...	...	...	287
9	Ash pan	...	142	2	...	28	172
10	Grates	...	64	2	...	19	85
11	Front end	...	82	4	...	...	86
12	Cistern	...	193	...	...	2	195
13	Tank frame	56	...	1	...	2	59
14	Tank trucks	82	...	4	...	65	151
15	Driving boxes	5	...	26	56	15	102
16	Trailer truck	58	...	19	...	11	88
17	Engine truck	56	...	16	...	13	85
18	Spring rigging	48	...	31	33	108	220
19	Brake rigging	3	...	27	40	40	110
20	Guides	42	...	16	8	...	66
21	Motion work	125	...	120	137	22	404
22	Crossheads and pistons	14	...	74	29	12	129
23	Main and side rods	26	...	63	76	3	168
24	Frames	224	...	32	...	36	292
25	Cylinders	150	...	32	...	8	190
26	Steam pipes	158	...	16	...	1	175
27	Shoes and wedges	49	...	20	...	...	69
28	Wheeling	51	...	...	...	...	51
29	Air pump	10	...	22	40	...	72
30	Air-brake equipment	...	...	4	71	1	76
31	Electrical work	...	...	1	38	...	39
32	Headlight	...	...	...	20	...	20
33	Pipe work	293	...	...	...	5	298
34	Running boards	73	...	...	...	5	78
35	Cab	273	...	...	...	2	275
36	Pilot	29	...	...	...	4	33
37	Cab fittings	...	...	...	108	...	108
38	Boiler fittings	142	...	29	...	14	186
39	Boiler studs	165	...	28	...	...	193
40	Jacket	...	...	...	47	...	47
41	Lagging	196	...	...	...	...	196
42	Driving wheels	107	...	10	...	...	117
43	Painting	214	...	...	...	...	214
44	Electric welding	90	...	...	...	...	90
45	Gas welding	277	...	...	...	...	277
46	Testing	123	...	...	...	...	123
	Total hours	3,296	3,433	636	703	474	8,542

A Dozen Don'ts for Shopmen

1. Don't monkey with a machine "just for fun." A machine can't take a joke.
2. Don't try to operate a machine for the first time without receiving full instructions from some one in authority.
3. Don't shift heavy belts by hand unless you are an expert, and even then great care should be exercised; it is better to use a stick.
4. Don't wear shoes with soles so worn that a splinter or nail will go through and cause serious injury.
5. Don't chip towards anyone without a screen up.
6. Don't stop a planer by half-shifting reversing belt; always stop it by the countershaft.
7. Don't set a lathe or a planer tool while in motion.
8. Don't allow a tool to run by the work so far as to cut into a lathe spindle. A machine may look strong, but it can be very quickly and easily damaged.
9. Don't scar the platen of a planer or make holes in a drill press table.
10. Don't lay files or any tools on the ways of a lathe. Use a tool board—don't cut into chucks or face plates.
11. Don't touch the teeth of a gear or cutters of any kind while in motion.
12. Don't lean against a machine that is running. It is far better to keep a safe distance from any mechanism that is in motion, or likely to be set in motion. Never ride a planer bed.—Railway Journal.

The Centerless Method of Grinding

A Method for Producing Cylindrical Surfaces with No Control of the Center of Rotation

By George W. Binns
Cincinnati Milling Machine Co., Cincinnati, Ohio

THE centerless grinder is a comparatively new development in the machine tool industry. This machine was first conceived as a single purpose tool, but on account of the extremely high productive features of the machine, it was found desirable for other work and was tried out on a great variety of jobs. As the word implies, it is a machine for producing an accurately ground outside cylindrical surface with no apparent control of the center of rotation.

The principal elements of a modern centerless grinder are: A grinding wheel, a regulating or feed wheel and a work rest. The work rest may be provided with suitable guides leading the work in line with the wheels, and receiving it therefrom, and these elements may be arranged and combined in any of a number of different ways, the fundamental principle involved being the same in all. The grinding, due to what may be called the cutting pressure, forces the work against the work rest. It also forces it against the regulating or feed wheel by what may be called the cutting contact pressure. This feed wheel is generally of a material similar to the grinding wheel itself, which provides a surface sufficiently rough to prevent any slippage between it and the work, causing the work to rotate at the same surface speed as the feed wheel itself. Its surface can be quickly renewed by a simple truing operation.

Lateral movement of the work past the grinding wheel when desired, may also be imparted by the regulating or feed wheel. This is accomplished by a relative tilt or angle between the feed wheel spindle and the axis of the work, that is, so that their centers do not fall in the same plane. In cases where the feed wheel has a face contact with the work, the same action is obtained by having the contact with the work at a point slightly below or above its center.

The traverse of the work through the machine can be

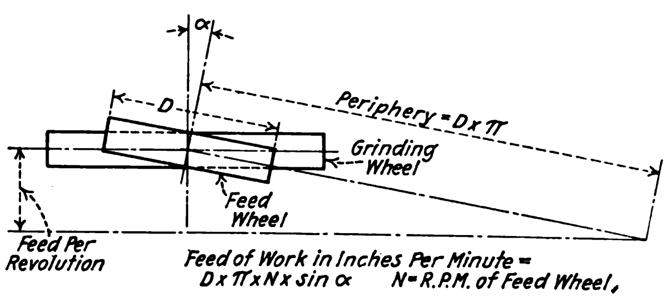


Fig. 1—Formula for Determining Feed Per Revolution

figured by the formula given, the factors being shown in Fig. 1. The feed is theoretical and based on the assumption that there is no slippage of the work whatsoever in its contact with the feed wheel, and it is remarkable how close actual results check with this, the error being usually within two per cent.

The action of the feed wheel makes it possible to accurately control the grinding condition because the rate of traverse of the work past the wheel and the rate of rotation of the work is easily set to any desired amount by simply changing the speed of the feed wheel and the angular setting of its spindle. This adjustable angular setting of the feed wheel corresponds to the feed box on the ordinary grinder for changing the rate of work traverse, while the feed wheel speed control corresponds to the feed box for changing the rate of rotation of the work head.

Advantages Claimed for Centerless Machine

The actual requirement for economical grinding is very much the same on center and centerless machines. There are, however, several distinct differences in the machines, the principal ones being as follows:

The centerless grinder is more productive because the grinding action is practically continuous. The actual rate of grinding is also faster because the work is supported more rigidly at the point of grinding, making it possible to use the grinding wheel to its limit while the center type machine depends principally on suspending the work between centers

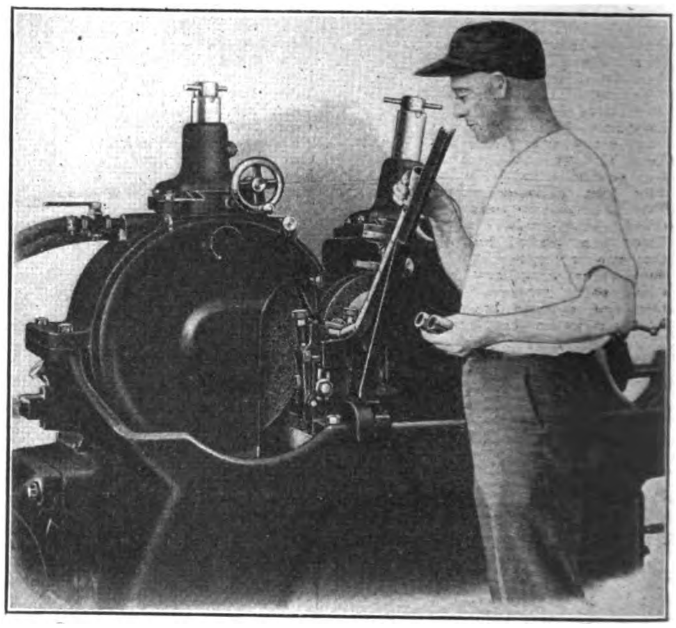


Fig. 2—The Machine Grinding Cylindrical Work by the Straight Through Method

which often limits the rate of grinding otherwise possible. There is a further gain due to the fact that it is not necessary to leave so much stock on the work which is to be ground, as the average job ground on the centerless grinder will clean up with one-half the stock required when grinding on centers. This is due to the fact that the centerless works to the nearest full diameter while center type machines work from a radius. This also permits of an effective saving on the wheel wear, and a further saving is secured since the centering operation is not necessary.

The average gain on production when a job is taken from a center type machine and put on a centerless is over three fold, and in many cases runs as high as ten and seldom below two. It is possible to obtain by the centerless method, work that is more accurate to size and more uniform in quality, due to the fact that the moving elements in the machine for any given operation are reduced to the absolute minimum, and this also materially reduces the skill required of the operator.

On many jobs that have been transferred to the centerless,

such as piston pins and similar work, the limits of accuracy specified have been materially reduced, with a large decrease in the percentage of scrap from the grinding operation.

These results are sufficient to justify considerable effort in making work adaptable to centerless machines. Many of the most successful installations of centerless grinding today are on jobs that a few months ago were considered impossible.

There are two popular methods of centerless grinding, both using the same basic principle. The first and most popular is commonly called the straight through method and is applicable to all straight cylindrical work, such as piston pins and straight rolls. Fig. 2 shows the machine properly set for

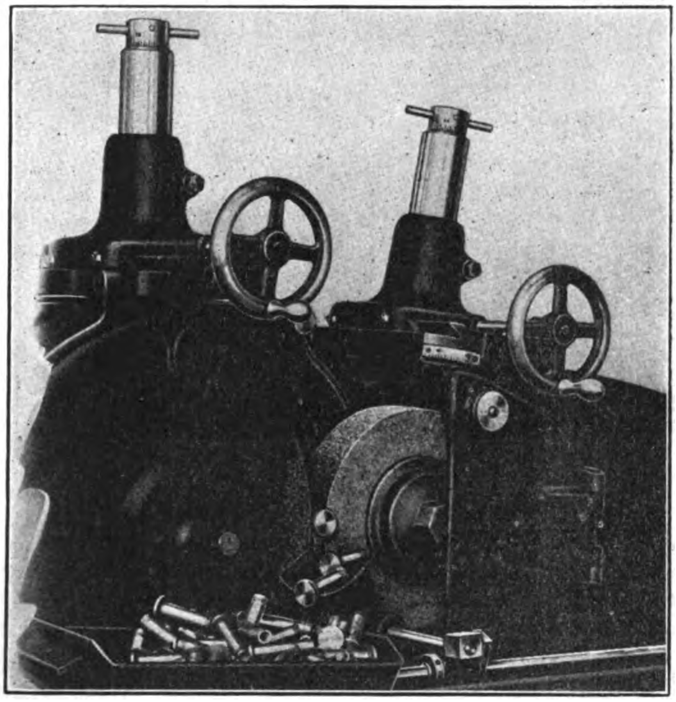


Fig. 3—Machine Set for the Shoulder Method of Grinding

this class of work. The second method is commonly called shoulder grinding, and the operation is somewhat different. In this method illustrated in Fig. 3, the work is placed between the wheels to an end stop, the wheels are then closed in to a set stop, thereby sizing the work and as the wheels are released to the original position the work is ejected.

The above principles of centerless grinding are an innovation within the last few years which have revolutionized the art of grinding cylindrical work.

Device for Removing Piston Rods

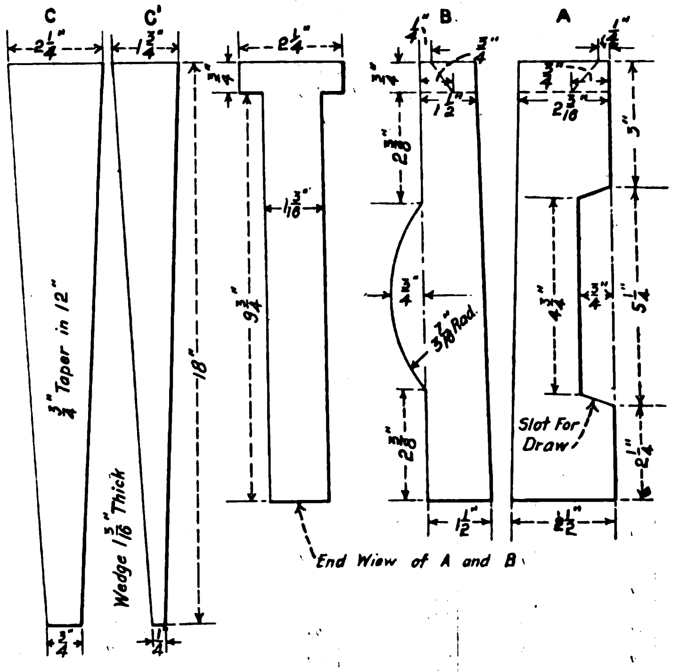
By Sidney H. Pratt

Special Apprentice, Baltimore & Ohio, Pittsburgh, Pa.

THE Glenwood shop practice bureau of the Baltimore & Ohio has recently developed a combination device which shortens the time required in enginehouse work to draw piston rods and crossheads to a tight fit or to break them apart, from 1½ or 1¾ hr. to 10 or 15 min.

In the employment of this device if it is necessary, for instance, to break the piston rod from the crosshead, after the preliminary operation of removing the key has been performed part *A* is dropped in the keyhole with the slot towards the rear, part *B* is next placed with its radius facing the front and either one of wedges *C* or *C'* is put in between the two pieces. If, then, force is applied by means of a sledge, the piston rod being the only movable body will break its fit with the crosshead. When it is desired to draw the piston rod and crosshead to a tight fit the position of *A* and *B* is reversed in order that the driving force on the piston rod will be towards the crosshead.

It will be noted that by using this combination device, the



Details of Wedges and Keys Used for Drawing Up or Breaking the Piston Rod Fit in Crossheads

necessity of spotting the engine and removing and replacing the main rod and wrist pin is dispensed with. The pieces *A*, *B*, *C* and *C'* are made of tire steel, forged and milled to the dimensions shown in the drawing.

A Useful Horizontal Tank Chart

By W. F. Schaphorst

A CHART that gives the gallons of a liquid in any horizontal tank without the use of tables, formulas, figures or computations of any kind is shown in the illustration. Its application can be better explained by working out an example: How many gallons are there in a tank 84 in. in diameter, 142 in. in length and having in it a liquid 30 in. deep?

Referring to the chart, run a straight line through the 84-in. in column *A*, and the 30 in., column *B*, and locate the intersection with column *C*. By means of the eye follow the radiating "guide lines" to column *D*, locating a second point of intersection. From this latter intersection run through the 142, column *E*, and locate the point of intersection in column *F*. Then from this point run over to the 84 in. in column *H*, and the intersection in column *G* will be found to be close to 1,050 gallons, which is the answer.

One of the principal advantages of this chart is that it takes care of any depth of liquid from 0.1 in. to the full capacity of the tank. All guesswork is eliminated. To make the chart clear there has been included sketches showing the diameter of the tank *D*, the depth of the liquid *H*, and the length of tank *L* with arrows leading from them to the proper columns. By following them no mistake can be made.

The range of the chart is amply wide. It will take care,

of any diameter from 2 in. to 200 in. and of any length of tank from 10 in. to 100,000 in. This chart will give an answer much more quickly than tables or formulæ and is surprisingly accurate. It is more complete than tables because it takes care of every dimension between 2 in. to 200 in., whereas tables generally skip many diameters and lengths giving only 24 in., 28 in., 32 in., 34 in., etc.

Since column *E* takes care of the lengths of tanks up to 100,000 in. it is plain that not only will this chart compute tanks, but it will include long pipes whenever it is desired to compute either their full or partial capacity. Inversely, the chart may be used very conveniently for determining the

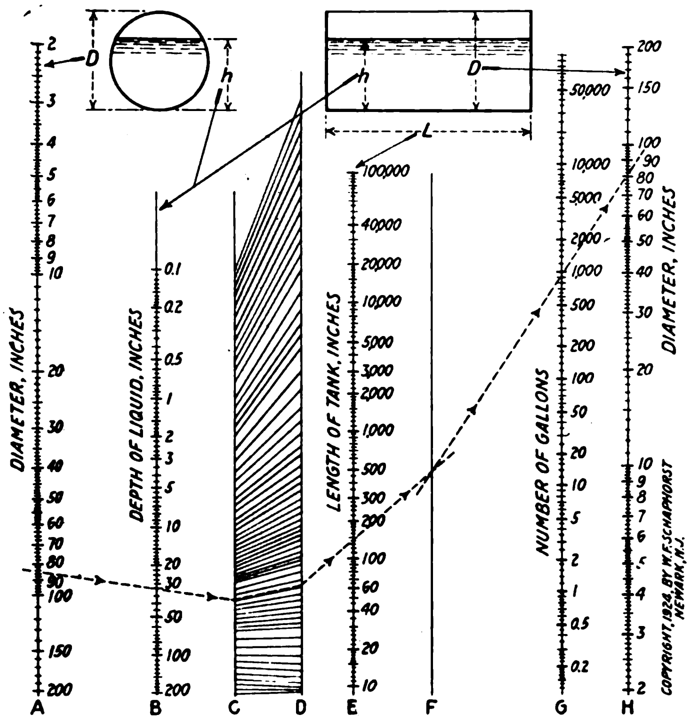


Chart for Determining the Number of Gallons of Liquid in a Tank

length of a tank necessary to hold a given number of gallons where the diameter of the tank and the depth of the liquid are known or are fixed quantities, as is often the case. The method of applying the chart to problems of this character is so obvious that further directions are unnecessary.

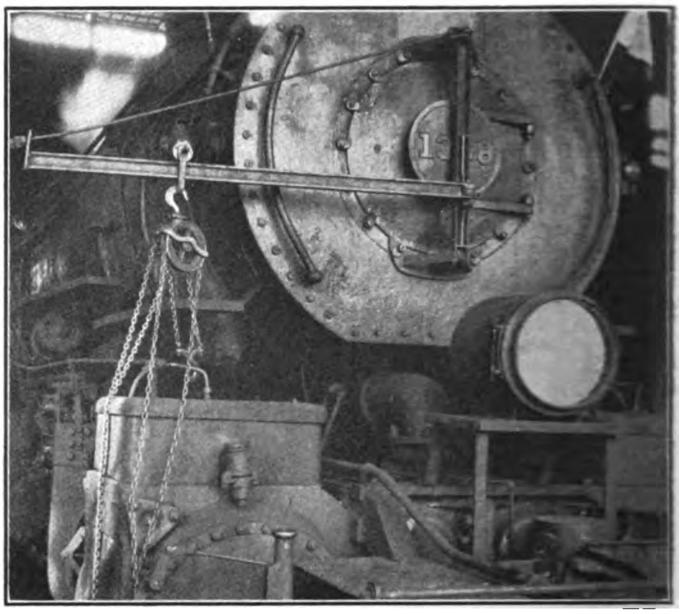
Crane for Removing Cylinder Heads in the Enginehouse

By George J. Lucas

Boilermaker Foreman, Norfolk & Western, Crewe, Va.

SHOPS and enginehouses at many outlying terminal points are not always equipped with sufficient jib cranes to handle emergency jobs. This is especially true if a number of such jobs come in at one time. One of the most frequent jobs of an emergency character that falls to the lot of the enginehouse, is that of cylinder repairs. The illustration shows a jib crane that can be bolted to the front end of a locomotive and made ready for service by two men in from four to five minutes' time. This crane has been primarily designed for lifting off low pressure valve heads and front cylinder heads.

It is constructed of light channel and steel plate and the connections are all electrically welded. The bracket from which the boom is swung consists of two U-shaped plates, cut and drilled to suit the circumference and bolt locations of the door on the front end, and a channel which is welded to these plates and braced on both sides. It extends out far enough to clear the number plate. A pivot bracket for the boom to swing on is welded to the channel, as shown in the illustration, and a tie rod is secured at the upper end by a bolt extending down through a small plate welded across the



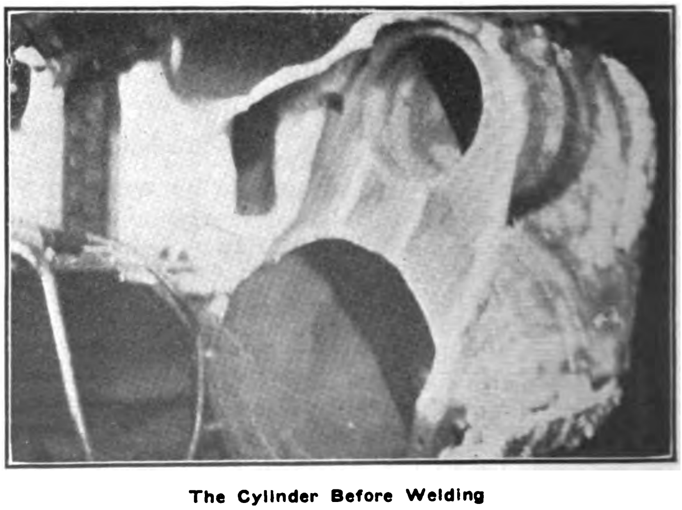
A Handy Jib Crane Which Can Be Set Up by Two men in Five Minutes

top at the bend of the channel. The boom can be made from a light channel or T-iron with a sufficiently wide surface on the top to carry a double-flanged wheel or roller. The usual type of chain hoist may be used with this crane.

After the crane has been adjusted, the work of removing the front cylinder head or low pressure valve head can be easily handled by one man; whereas, to do this work by hand, it generally requires from four to five men. Aside from being a labor saver, the liability of personal injury is also greatly reduced.

Cylinder Welded at Small Cost

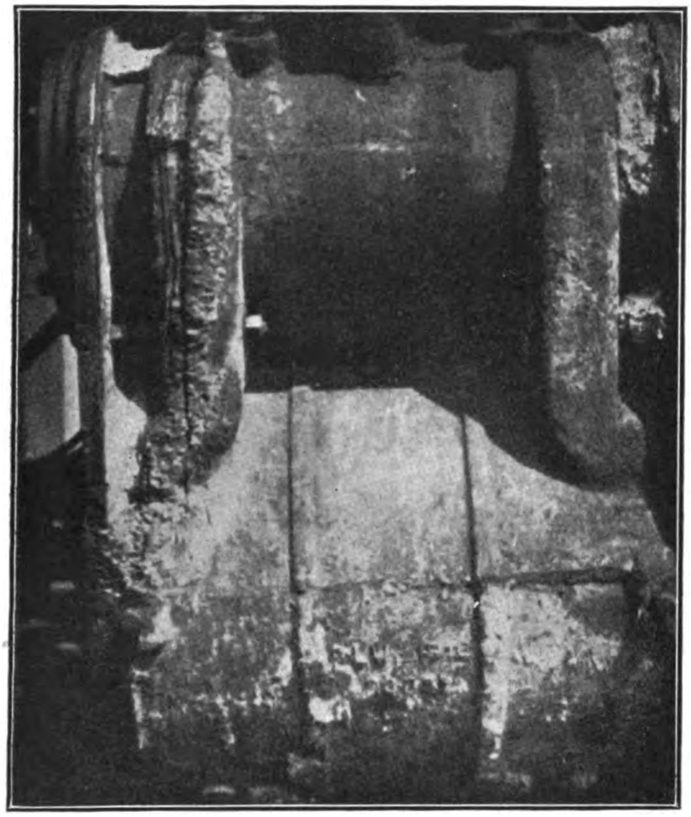
AN interesting job of cylinder welding, from the standpoint of economy, was recently performed in the East Buffalo, N. Y., shops of the Lehigh Valley. The cylinder on the left side of a Pacific type locomotive was broken as shown



The Cylinder Before Welding

in one of the illustrations. The portion broken off was in three pieces, which made the repair work quite difficult. However, after a careful inspection it was decided to weld the broken parts together instead of replacing with new cylinders.

The cracks were chipped out by a machinist and a helper. This work required 20 hours. The cylinder was lagged except at the breaks, and heated with a charcoal fire. On account of the size of the breaks three welders were used to



The Cylinder After the Welding Was Completed

do the work so that the job was completed with the one heating.

The actual cost of this job amounted to only $140.92. The various items are shown as follows:

Chipping, 20 hrs.:	
Machinist	$14.80
Helper	6.11
Three welders, 12 hrs. each	36.54
22 torch hrs	36.30
115 lb. Tobin bronze	41.40
2¼ lb. flux	1.37
20 bushels charcoal	4.40
	$140.92

Preventing Shoes and Wedges from Breaking in Service

LOCOMOTIVE driving box shoes and wedges, especially those with short side flanges, as shown in Fig. 1, frequently break in a manner similar to the crack shown at *D*. This is caused by the projecting end of the shoe, *B*, being forced away from the pedestal jaws by the radius at *A*. This difficulty can be overcome by making a longer radius on the end of the shoe or wedge which is shown by the dotted line at *A*, Fig. 1. Clearances cut, as shown at *C*, will overcome the bad effects of face wear, but this advantage is offset by the weakening of the shoe at a critical point.

A more successful method which may be used to reduce breakage is to weld triangular blocks, *A*, into the corners of the jaw openings, as shown in Fig. 2. An amount equal to the width of the block is cut from the top of the shoe or wedge at *A*, referring to the sketch *a* in Fig. 3, to give an

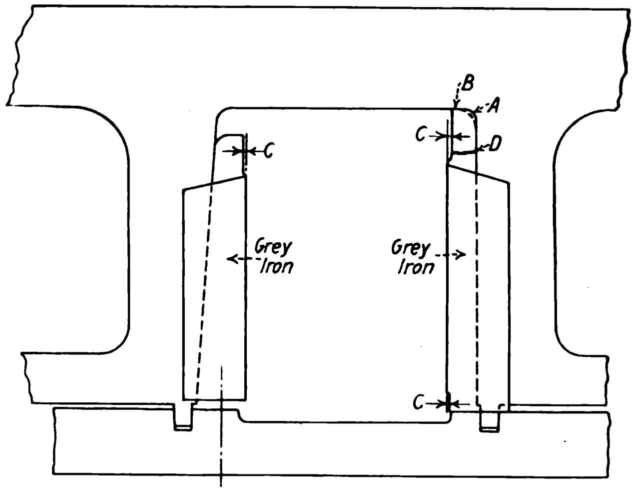


Fig. 1—Sketch Showing the Break in the Shoe Caused by Its Being Forced Away from the Pedestal Jaw Face by the Corner Radius

end bearing. If the shoe or wedge pattern were beveled at the upper end as shown at *D* in the sketch *b*, Fig. 3, an end bearing would be obtained that probably would be better than that shown in Fig. 1, although the bearing area would be less.

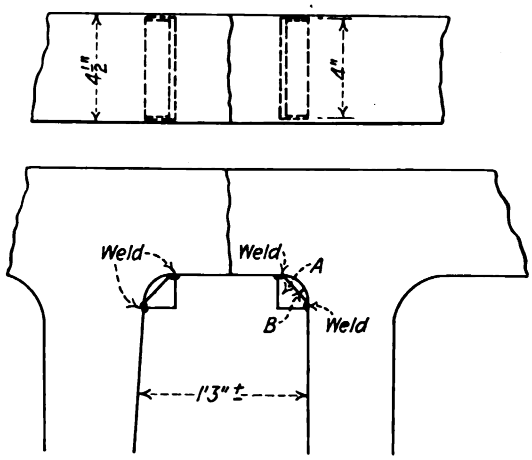


Fig. 2—Blocks Are Welded in the Corners to Give the Shoe or Wedge an End Bearing

Another method that has been recommended to prevent breakages is shown in the sketch *c*, Fig. 3. The frame could be designed with a clearance in the corner of the pedestal

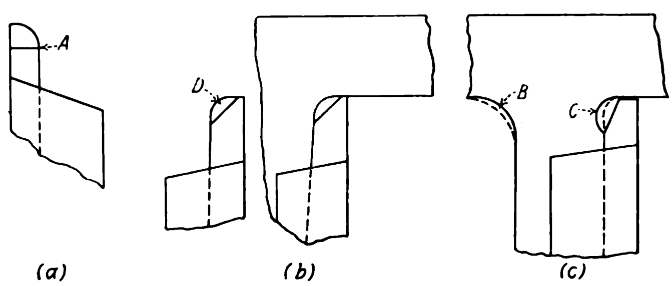


Fig. 3—Sketches Showing Different Methods of Preventing Shoes and Wedges from Breaking at the Ends

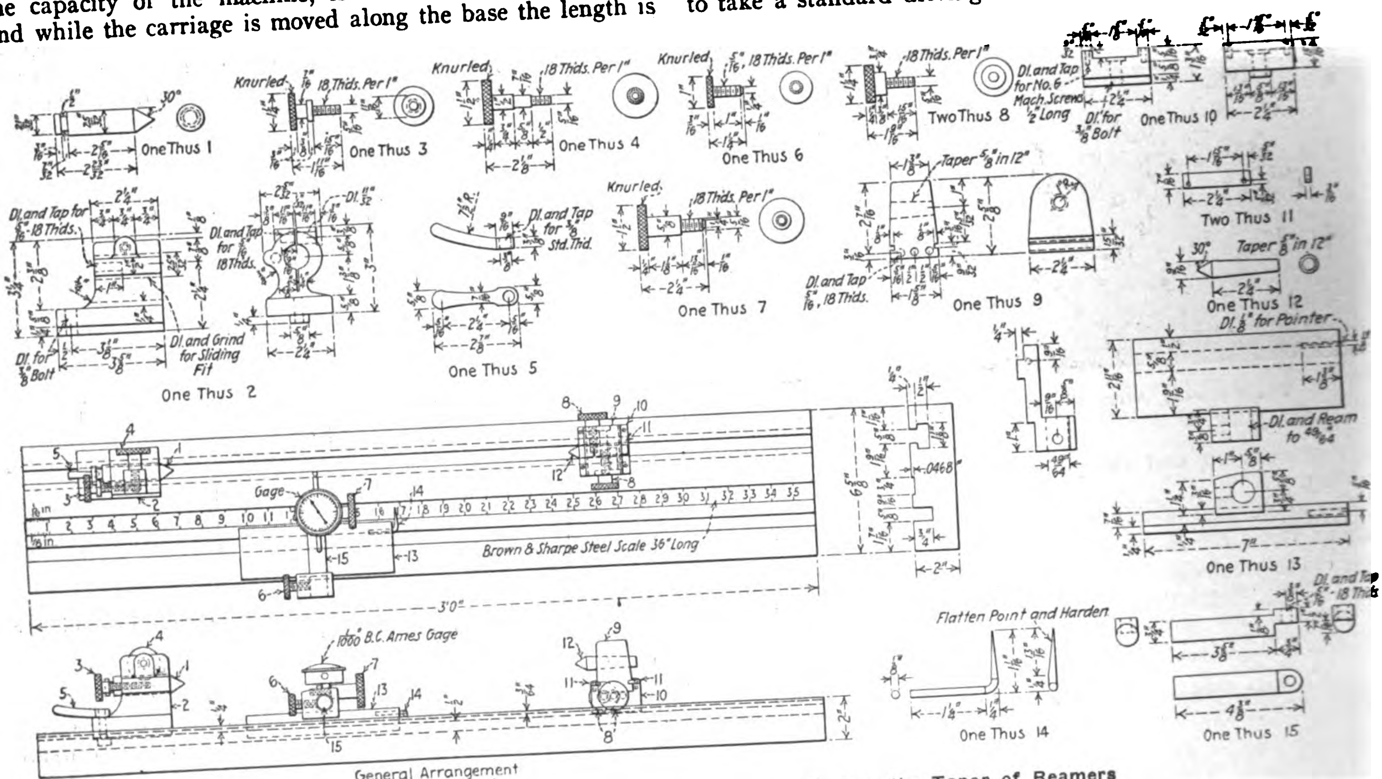
jaw as shown at *C*. The loss in metal could be compensated by additional metal in the outside corner of the pedestal jaw at *B*. The most satisfactory results, however, are being obtained by using the method shown in Fig. 2.

Taper Testing Machine

In nearly all up-to-date railroad shops the bolting-up of a locomotive has become a standardized process. Different sized bolts of one taper, usually 3/16 in. to the foot, are accurately machined and placed in stock. This practice has naturally created the necessity for a machine to test the accuracy of the taper on reamers and bolts in order to facilitate fitting.

The illustration shows the general arrangement and details of a machine which has been designed for this purpose. It consists of a 36-in. base with two sliding stocks equipped with centers, one of which is adjustable. A carriage slides in a separate channel and upon it is mounted a dial test gage which is graduated to read in thousandths of an inch. The position of the test gage with reference to the centers is adjustable.

When a hole has been reamed preparatory to fitting a taper bolt, taken from stock, it often happens that the reamer used does not have a taper which corresponds exactly to the bolt, due, possibly, to carelessness on the part of the toolroom mechanic who grinds the reamers. By the use of this testing machine the taper on the reamers can be easily and rapidly checked up. A reamer of any length, within the capacity of the machine, is fixed between the centers, and while the carriage is moved along the base the length is shown by the reading given by the pointer and the graduations on the 36-in. steel scale, while the exact taper can be figured from the readings of the dial indicator.

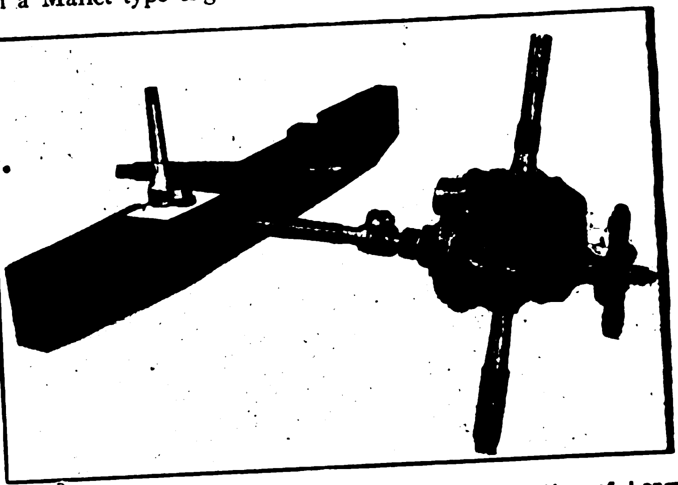


General Arrangement and Details of Machine for Testing the Taper of Reamers

Device for Inserting Long Bolts

By J. J. Sheehan
Roanoke, Va.

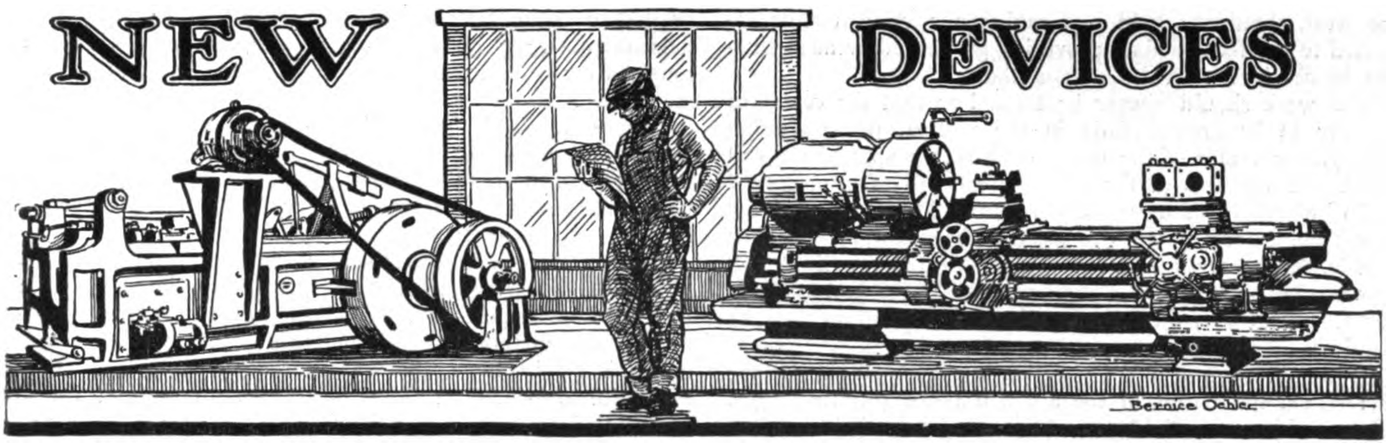
When a mechanic finishes pulling a close fitting bolt, which has threads 1¼ in. by 12 in., through a piece of work with 4 in. of threads, using a hand wrench, he realizes that he has done something. Aside from the element of fatigue, considerable time is also consumed in running all of the wedge adjusting bolts for pedestal binders into place on a Mallet type engine. This also applies to putting flexible staybolts in boilers. The difficulty in this case is increased on account of the round head which is not suitable to take a standard driving socket.



A Driver Which Facilitates the Removal or Application of Long Threaded Bolts

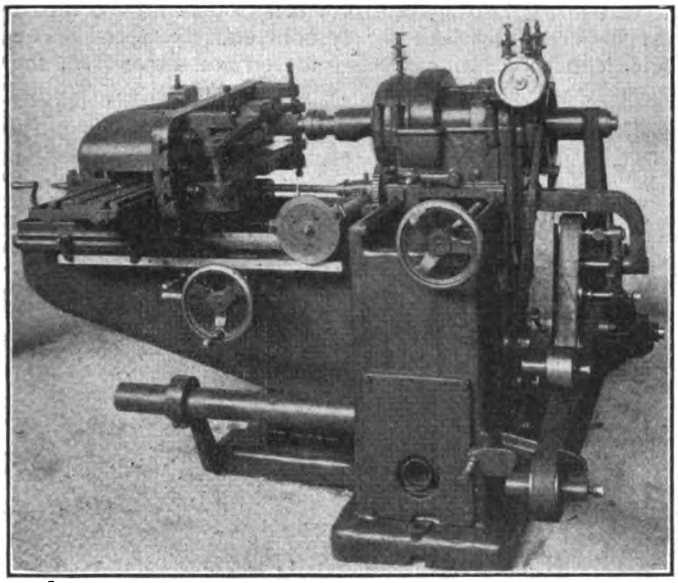
In order to overcome this difficulty a driver with a Morse taper shank was developed which consists of a round hollow socket designed to go over the head of a bolt. This driver, which is shown in the illustration, has an opening on the side to permit an eccentric wheel with a knurled and hardened face to come in contact with the head of the bolt. Thus the harder the pull, the tighter the grip. By throwing the wheel to the opposite side, the action can be reversed and the bolt turned out as well as in. By attaching this device to a pneumatic motor, the labor of inserting long threaded bolts can be reduced to a minimum.

This device saves considerable time and hard labor when running up all of the wedge adjusting bolts for the pedestal binders and also when putting in flexible staybolts in boilers.



An Internal and Link Grinding Machine

THE internal grinder, made by the Gisholt Machine Company, Madison, Wis., for grinding holes in locomotive motion work, air pump cylinders and similar parts has been equipped with an attachment for grinding links and link blocks. This attachment greatly increases the field of usefulness of the machine so that, besides being



Gisholt Internal and Link Grinder Set Up for Truing Worn Link

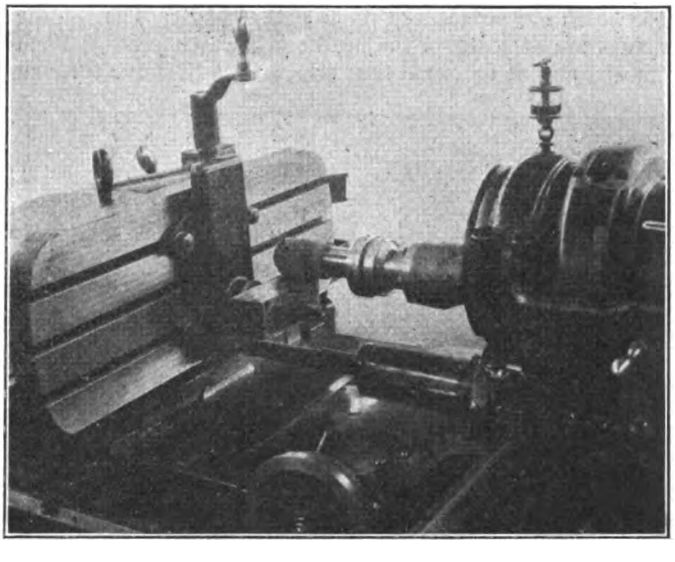
suited to use in large railroad shops, it can be installed with profit in comparatively small shops and enginehouses which may not have enough internal grinding and radius grinding work to justify the purchase of two separate machines.

The cross sliding head of the new Gisholt grinder and the generous travel of the knee give a wide range of adjustment. The table travels back and forth for grinding length and the headstock crosswise for central and center to center adjustment. This adjustment reduces the overhang of the work to a minimum, an important feature when grinding the low pressure cylinders of cross compound air pumps, for example. The machine has a capacity to grind 2¾-in. to 4½-in. holes, 13 in. deep and 4½-in. to 8-in. holes, 16 in. deep. By means of special spindles furnished as extra equipment, 1-in. holes can be ground up to 5 in. deep; also 8-in. to 14-in. holes up to 16 in. deep.

The link or arc grinding attachment is mounted on the work table and consists of a cross slide table in the center of which is located a pivot, carrying a cradle free to rock on the pivot. A rail pivoted in the same horizontal plane as the pivot for the cradle and having an angular adjustment in the vertical plane, controls the rocking motion of the cradle as the cross slide travels back and forth.

The grinding wheel spindle, located in the same vertical plane as the rail pivot, remains stationary so that the combined movement of the cross slide and the cradle will produce a circular arc tangent to the grinding wheel. The center of this arc is located on a line perpendicular to the cradle through the center of its pivot. The angular adjustment of the rail for the desired radius is obtained from a chart mounted on the attachment.

The cross slide table is driven by power from the regular table feed screw which is provided with a clutch for disconnecting the work table power feed. The power movement of the work table and the cross slide, therefore, cannot take



Close-Up View of the Attachment As Used for Grinding a Link Block

place simultaneously, but hand feed is always available for the work table, so that occasionally it can be moved back and forth to insure even wear of the wheel and a parallel surface.

The feed trip and reverse lever controls the reverse motion of the cross slide table through the regular table trip mechanism which also can be operated by adjustable trip dogs on the trip disc when automatic reverse is required.

When grinding internal arcs, such as locomotive links, the work is secured to the fixture plate by means of suitable clamps; but when grinding external arcs, such as link blocks,

the work should be held preferably on a vertical slide attached to the fixture plate providing greater adjustment than can be obtained with the knee of the machine.

The work should always be located so that the center of the arc to be ground falls in the vertical plane passing through the center of the wheel spindle, the axis of the rail pivot, and the axis of the cradle pivot—all of which must be in line whenever the work is set up. The chart gives the set-up angle for selected arcs passing through the rail pivot; that is, the mean arc when referring to locomotive links and link blocks. To bring the abrasive wheel in contact with the surface of the arc, the knee is raised or lowered as the case requires.

If the guide rail is set parallel to the movement of the cross-slide, the radius of the arc will be of infinite length. The machine, therefore, can be used for straight surface grinding without removing any part of the attachment. If desired to grind straight surfaces on work which cannot be held conveniently on the fixture plate, the cradle can be removed easily and the work placed on the horizontal cross slide table.

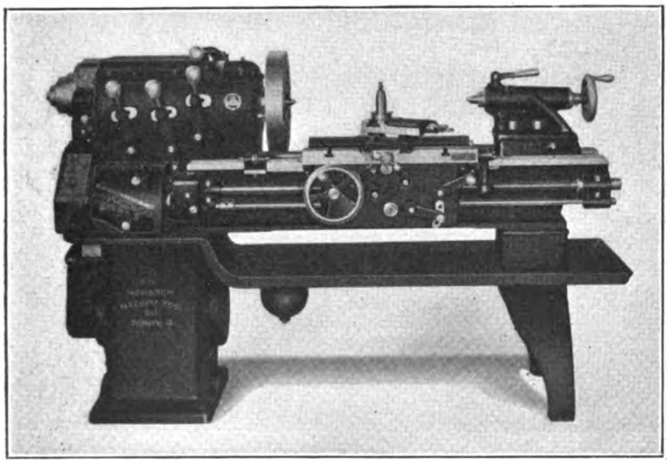
A special spindle is supplied to accommodate the wheels used in arc grinding. When using the machine as a surface grinder with the cradle removed, the regular internal grinding spindle is used, except for heavy duty, when a special heavy spindle is preferable.

The length of the cross slide table is 34 in. and the width 7½ in. The length and width of the fixture plate are 26 in. and 10½ in. respectively. The table has 30 in. cross movement. The surface speed of the table is 2.5 and 4.8 ft. per min. A 2¼-in. to 2½-in. wheel is used with a ¾-in. hole and 3-in. to 4-in. face. The total weight of the machine is 3,100 lb. and a 5-hp. motor running at 1,800 r.p.m. is recommended.

Geared Head Lathe with Helical Gears

THE Monarch Machine Tool Company, Sidney, Ohio, have recently put on the market a geared head lathe with helical gears. The primary object of helical gears in the lathe head is to overcome noise, shock, vibration and tool marks on the work.

The helical gears are alloy steel drop forgings which give a noiseless, smooth, constant transmission of power as three and one-half teeth are always in mesh. The auxiliary shafts are mounted in heavy double row confined radial thrust bearings. All the gear and spindle end thrust is taken against the ball thrust bearings. All changes of spindle speeds are made with three levers operating heavy, double sided jaw clutches. The moving double clutch members slide on squared sections of the spindle and the intermediate shaft. The spindle speeds are all selective and can be made while the lathe is running. The gears run constantly in an oil bath in an oil tight head stock which has no gears in the top cover plate. The spindle bearings are enclosed in the head stock which protects them from dirt and at the same time are easily adjustable through



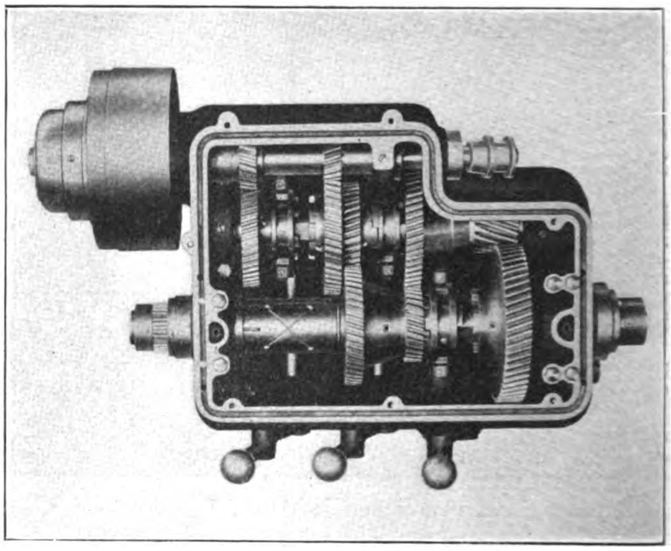
Monarch 14-in. by 6-ft. Ball Bearing Eight-Speed Helical Geared. Self-Contained Motor Driven Lathe

cover plates in the headstock cover. The front and rear spindle bearings are 3 in. by 5 in. and 2¼ in. by 4¼ in., respectively.

The machine is provided with a multiple disc type of friction driving clutch with both a headstock and apron control for starting, stopping and braking the spindle. The spindle and auxiliary shafts with the complete gear and clutch assembly fit into place as a unit.

The clutch has only one point of adjustment which can readily be reached from the outside. It is driven through an endless belt with a ball bearing adjustable idler pulley, or a silent chain.

The headstock contains ten chrome-nickel steel forged gears having from 16 deg. to 18 deg. spiral angle. The two auxiliary shafts run in a double row of heavy ball bearings. Six ball thrust bearings are provided to take all the thrust wear developed by both the spindle and the gears. The double clutch operating spools slide on and drive from the



Inside View of the Eight-Speed Helical Geared, Ball Bearing Headstock, Showing the Multiple Disc Friction Drive Clutch and Gears

large squared sections of the intermediate shaft and spindle. All the gears are in an oil bath and the splash system carries a flood of oil to all the working parts. The spindle bearing cap screws are adjusted by a socket wrench through the removable cover plates in the top cover.

The initial driving shaft, on which the multiple disc driving clutch is mounted, is hollow and through it extends the clutch operating shaft on the front of which a friction cone clutch is mounted. When the friction clutch is disengaged by either the headstock or the apron control lever, the head can be allowed to drift or instantly be brought to a stop at the will of the operator.

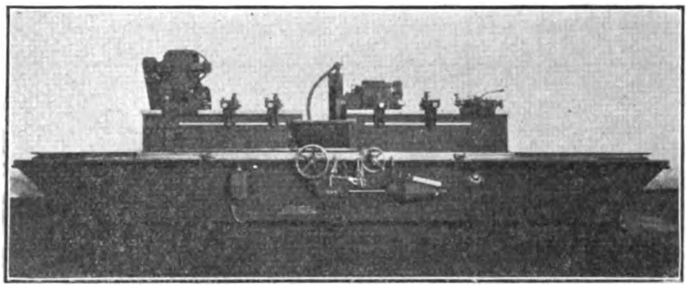
The motor can be located either in the cabinet leg of the lathe or on top of the headstock. It is mounted on a hinged adjustable bracket which provides adjustment for the belt or

the silent chain used for driving. This adjustment is made from the outside. The motor starting apparatus can either be mounted inside or on the rear of the tailstock leg. A 2 to 3-hp., a. c. or d. c. constant speed or adjustable speed d. c. motor not exceeding 1,200 r.p.m. is recommended.

Some of the principal dimensions of the 14-in. by 6-ft. lathe are as follows: Swing over the bed, 14¼-in.; swing of the carriage, 9¾-in.; distance between centers with the tailstock flush, 2-ft. 6-in.; hole through the spindle, 1 9/16-in.; center Morse taper, No. 4; range of threads per inch, quick change, 3 to 46; range of feed per inch, quick change, 7½ to 115; carriage length, 24-in.; size of lathe tool, ⅝-in. by 1 ⅜-in.; speed of geared head driving pulley 545 r.p.m.; weight without the motor, 2,600 lb.

Piston Rod Grinding Machine

A MACHINE designed for grinding locomotive piston rods with the pistons in place has recently been brought out by the Norton Company, Worcester, Mass. It is also suitable for grinding axles, valve rods and any other long cylindrical work within its capacity.



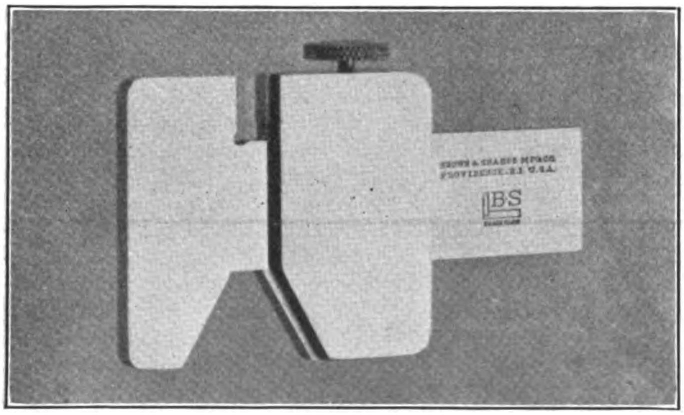
Norton Grinding Machine Provided with a Gap Which Permits the Grinding of the Largest Locomotive Piston with the Head Attached

The machine is of the gap type and is made in three lengths between centers of 96 in., 120 in. and 144 in. with a swing over the table of 16 in. and a gap swing of 40 in. The gap is located in the center of the table and is 19 in. wide. Other widths of gap varying from 13 to 43 in. and positioned at any point along the table to suit the work to be done, can be furnished.

The headstock mounts a 2-hp. motor for revolving the work, which turns on dead centers. This motor is of the variable speed type in order to obtain the necessary changes in work speed. A large diameter screw running in a half nut lapped to fit, produces a wheel feed of micrometer accuracy. The feed is operated by an index gear wheel in front of the machine capable of advancing the wheel to reduce the work diameter by 0.00025 in. or multiples of this amount. The index crank allows of rapid traverse of the wheel head in changing from one diameter of work to another. The grinding lubricant is pumped from a tank in the base of the machine by a pump of the centrifugal type.

Thread Tool Gage and Micrometers for Small Diameters

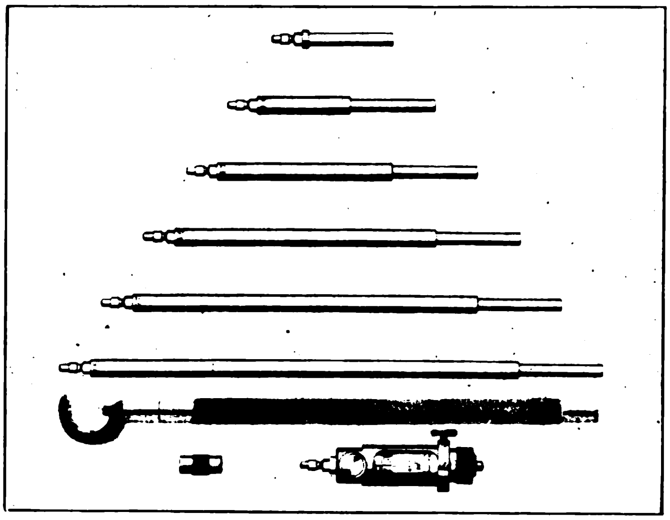
THE Brown & Sharpe Manufacturing Company, Providence, R. I., has recently added to its line of tools a thread tool gage and an inside micrometer. Thread tool gage No. 577 is made of a high quality of steel and the angles of the measuring surfaces are carefully hardened, ground and tested for accuracy. It is possible with this gage to measure or check thread cutting tools from a sharp V to a 1-in. flat. All widths of flats within a given angle can be conveniently obtained with the gage. The three different gages cover the United States, the Acme and the



Thread Tool Gage Which Measures or Checks Thread Cutting Tools from a Sharp V to a One-Inch Flat

Whitworth standards, having the angles of the measuring surfaces ground to 29 deg., 50 deg. and 60 deg., respectively.

To set it, a plug gage or a piece of stock the width of the flat required is inserted in the opening on the top which corresponds with the flat at the top of the angles. The gage with the 29-deg. angle can be used for checking either 29-deg. screw threads or 29-deg. worm threads. As the widths of the flats on worm and screw threads are different, one



Inside Micrometer Provided with a Lock Nut and a Handle for Holding It When Measuring Small Holes

ordinary slot gage is required to take a 29-deg. screw thread tool and another to take a 29-deg. worm thread tool.

The inside micrometer No. 264, shown in the illustration, has a range of measurements of from 2 in. to 8 in. by thousandths of an inch. It is provided with a lock nut which is claimed to be the first inside micrometer of this type. It consists of the head with a ½-in. measuring screw, six rods and one spacing collar. The shoulders on the rods fit in the

micrometer and when in position with the shoulder of the rod against the head, the first one-half in. can be measured from 3 in. to 3½ in. When the spacing collar is in place in the rod, the last ½ in. should be measured from 3½ to 4 in.

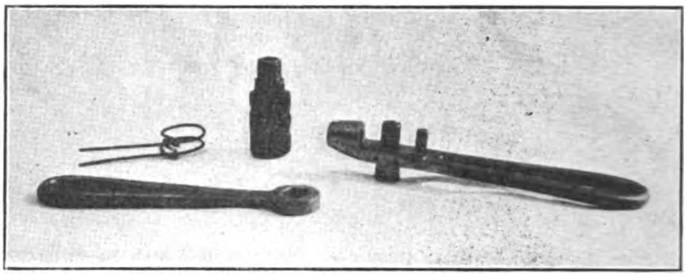
The principal feature of this micrometer is the clamping device. The outer shell of the micrometer is slit in two places. The metal between the two slots forms a shoe which is forced against the micrometer thimble of the thumb screw. This allows the thimble to be locked at any reading and prevents it from turning while being used. The measuring ends of the rods are hardened and so designed that it is possible to adjust them to compensate for wear by loosening the lock nut and turning the screw.

The inside micrometer handle No. 287 has been designed for use in connection with this micrometer. The handle consists of a hook with an adjusting brass plug which is held against the micrometer head by turning the knurled handle. In measuring the diameter of small holes, it is often difficult to hold the micrometer and get accurate measurements. With this handle, the inside micrometer can be inserted in the small holes for a greater distance than by the hand alone. The hook end of the handle fits snugly around the body of the micrometer and the brass plug will not mar the tools.

A Compact Hose Clamping Tool

A COMPACT device for attaching a wire band to any size of hose has been put on the market by the Gunn Manufacturing Company, Keene, N. H. Only three lengths of bands are required to fit any size of hose from ¼-in. to 3½-in.

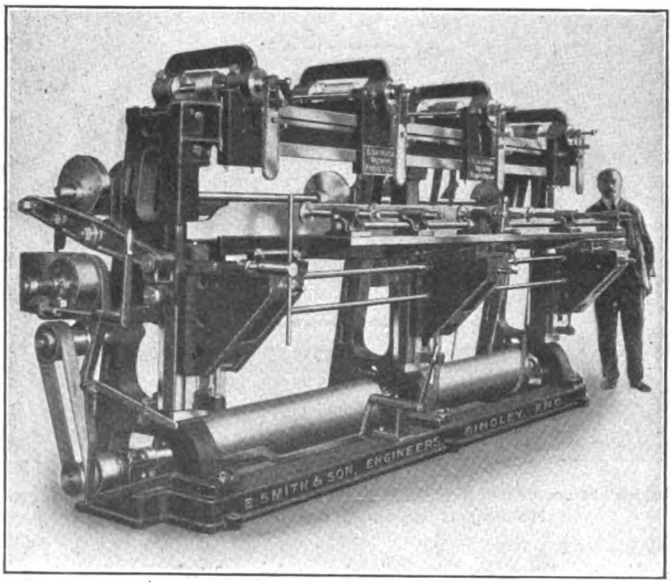
To apply the clamp, bend the wire band around the hose, pulling the ends of the wire through the nose of the tool and continuing it through the slot in the turning pin. Tighten the band by use of the wrench, then twist the ends of the wire until they break off. This leaves a small upright part of the band to be folded over and pounded flat. The result is a tight, smooth clamp, gripping the hose in a perfect circle and having no projecting parts. It may be tightened until it is indented into the hose itself, if so required, this operation depending only upon the strength of the wire used. The clamping can be completed in half a minute.



A Device for Clamping a Wire Band on Any Size of Hose

Mortising Machine for Use in Car Construction

THE B. SMITH & SON, Bingley, England has recently added to its family of wood working machines an improved gang-chain mortising machine, designed to enable accurate mortises to be produced in coach timbers without having previously to lay out the holes. The table will handle two pieces of wood 10½ in. deep and 4½ in. thick and up to 30 ft. long, and will mortise eight holes at one operation without the necessity of moving the timber. This ensures that the holes shall be accurate as regards center distances and is of considerable assistance when building up the framing on mass production.



A Machine Which Will Mortise Eight Holes at One Operation Without Moving the Timber

Mounted upon the top rail of the machine are four main heads which carry the mortise-chain spindles. Each head takes a double-sprocket wheel and two tension bars, these bars being spaced a correct distance apart to produce two mortises at a given distance in relation to each other in the two timbers being mortised. These mortise heads are not fixtures but can be traveled along the top rail by means of a rack and pinion, and in addition to this the two inside heads can be brought forward or taken back, so that mortises may be cut in front of or behind any given center line. The table or fence carrying the timber is fed up to the chains by means of rocking levers and cams, and this system of feed motion allows the chains when entering the timber to enter slowly, and when they are submerged in the wood the feed motion automatically speeds up and completes the mortise. When this is completed the cams have passed their highest point, and are designed to give a rapid downward motion, so that the return of the table is, roughly, 50 per cent quicker than the up feed.

This system of feed motion through cams overcomes to a great extent the danger of the chains splitting or slivering the timber when entering. The feed motion is driven off the left-hand end of the machine by a belt, and the drive is transmitted through a cone friction clutch which is spring loaded, the tension being variable through a pair of check nuts, which can be set at the will of the operator. In the event of a mortise chain breaking while cutting, the tension bar supporting this would come in contact with the timber, and the resistance thus offered to the feed would cause the friction clutch to slip, so that no damage would be done to the machine.

There is a reversing gear fitted into the drive mechanism which enables the table to be reversed and run down to

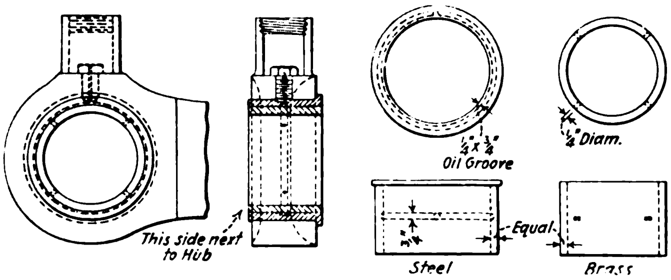
the bottom during any part of the upstroke, and this would also be useful in the event of a chain breaking. There are two rates of feed to the table to enable the machine to cope expeditiously with either large or small mortises.

The table has a constant power feed of 8 in., but there are screw jacks at the three knee brackets, interconnected through bevel gears which allow the table to be raised or lowered from any of the three knee brackets, to accommodate different depths of timber. The main table has a horizontal traverse of 18 in. and a cross-traverse of 6 in., so that any variation is provided for. There are also dead stops to the longitudinal traverse. The clamping motion of the table is all controlled from one point; the operator turns a balanced handle and this brings up four gripping pads simultaneously.

Hoffman ball bearings are used throughout in this machine. In the spindles double-row roller bearings are fitted to the front and also to the back. Ball-thrust washers are put in wherever end thrust is likely to require them. The whole of the gearing is of steel, machine-cut. The net weight of the machine is 5¼ tons, and it is supplied either for belt drive or can be motor-driven through a coupling, direct-coupled.

Combination Rod Bushings for Locomotives

A COMBINATION rod bushing for locomotives has been designed and patented by E. M. Carroll, assistant enginehouse foreman on the Atlantic Coast Line, Sanford, Fla. The object of the bushing is to feed the lubricant to the pin in a simple and effective manner.



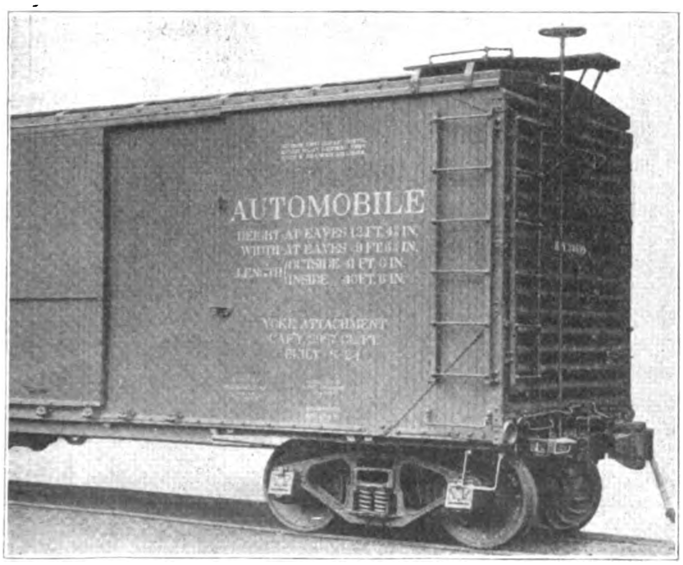
Rod Bushing Which Lubricates in Any Position, Tight or Loose

The drawing illustrates the principle of the bushing. It consists of a cast steel outer bushing and a brass inner bushing. The steel bushing has turned in its inner circumference a ¼-in. by ¾-in. annular groove. The brass bushing has cut in it four radial grease ducts which are arranged at equal distant intervals and are about ¼ in. diameter. These grease ducts lead to the circular groove in the steel bushing which properly distribute the lubricant on the crank pins from the grease cups located on the rods. This arrangement will lubricate in any position, tight or loose.

The steel bushing, after being pressed into the rod, can be electric welded as it does not have to be removed for an indefinite period. It is claimed for the device that it saves labor and material as it requires only half the brass that is usually used for the regular type of bushing. After the first application labor is saved as it is not necessary to remove keepers, drill or tap keeper holes.

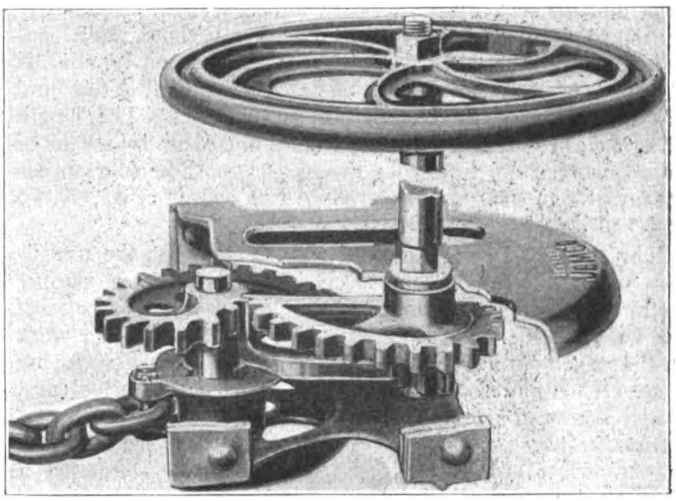
Hand Brake with Quick Take-Up and High Force Ratio

IT is generally recognized that besides simplicity there are two fundamental, opposing requirements of the efficient hand brake; namely, the ability to take up slack quickly and yet give a powerful brake application when the shoes



Jemco Power Plus Hand Brake Applied to Automobile Car

are in contact with the wheels. These requirements have been met by a unique arrangement of cam gears in a new hand brake for freight cars, developed by the Jemco Products Company, Chicago. This brake, known as the Jemco power plus hand brake, is shown in one of the illustrations applied to an automobile car and in the other illustration with the housing cut away to give a view of the helical gears. An examination of the latter illustration will indicate that in release position the ratio of movement of the brake wheel and shaft is approximately one to three of the shaft on which the brake chain is wound. In other words, slack in the chain and brake rigging is taken up rapidly



Housing Cut Away to Show the Helical Gears in Release Position

when the brake wheel is turned through the first one-quarter or one-half revolution. Continued turning of the brake wheel increases the brake shoe pressure until, at approxi-

mately 1¼ turns, the ratio of one to three has changed to three to one and a pressure is obtained between the brake shoes and wheels equivalent to that afforded by 50 lb. air pressure in a 10-in. air brake cylinder. This is assuming a pull of 125 lb. on the brake wheel which can be considered a conservative figure.

The Jemco hand brake can be fully applied without the aid of a brake stick in 1½ seconds and comparative tests indicate the advantage of this brake over the ordinary type of hand brake with sheave wheel. In a specific test it is reported that two composite gondolas, loaded with coal and having a total weight of about 160,000 lb. each, were coupled together in a freight classification yard and handled as a unit over a "hump" with a 2¼ per cent grade. One car was equipped with a Jemco and the other with an ordinary hand brake. The cars were allowed to obtain full momentum in a distance of 1,048 ft., the rider then applying the brake and stopping the cars in the shortest distance possible. The distance traveled to a full stop after the application of the ordinary hand brake was 2,078 ft., and the time required in making the stop was 1 minute and 52 seconds. The test was repeated, applying the Jemco hand brake. In this case the distance traveled was 1,400 ft. and the time 1 minute and 15 seconds. As a result of this and other tests, a large number of Jemco brakes have been applied to new and old freight cars and are now in service on several roads.

The Jemco brake is simple in construction and may be easily applied. It can be slipped over the lower end of the brake mast and the housing secured to the end sill, replacing the ordinary stirrup. The gears are effectively shrouded and supported by the malleable iron frame which not only shields them from damage by falling lading but protects them from ice and snow. All multiplying levers, sheaves, etc., are eliminated. The brake when set by hand is said to be practically as tight as it could be set with a club. The proportions of the helical gears used can be so made as to give any desired braking power.

Vertical Shaper Equipped with a Rotary Table and Improved Tool Head

The Pratt & Whitney Co., Hartford, Conn., has placed on the market a redesigned 6-in. vertical shaper, designated as the model B. The machine consists of a solid bed which mounts a rotary work table, and a column which supports the vertical ram and contains the ram-actuating mechanism. Angular adjustment is provided for the ram. The machine is designed for either a built-in motor drive or a single-pulley belt drive from a line shaft. In either drive the speed of the main drive pulley is 450 r.p.m.

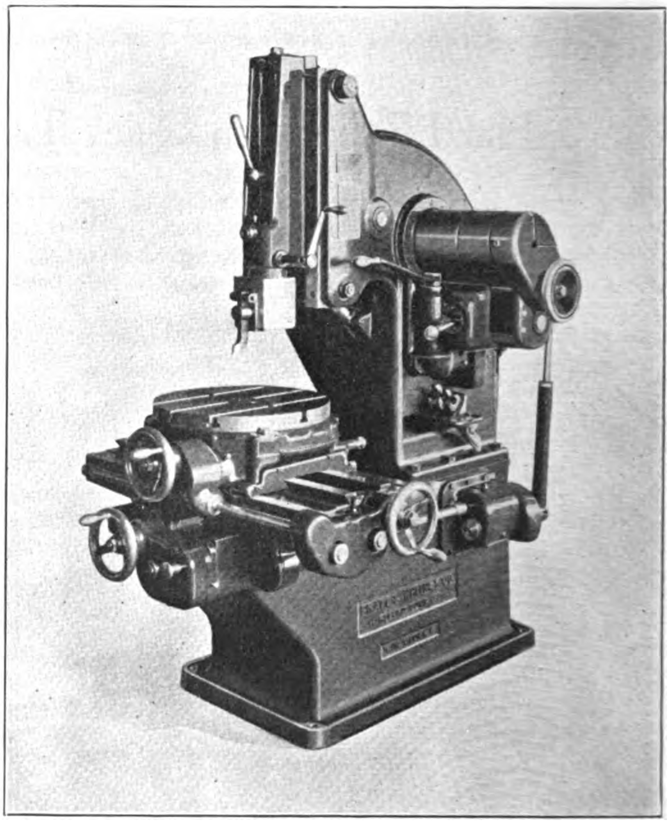
The power is taken into a gear box on the right-hand side of the column, and the selective gear drive provided to the ram is a feature of the new machine. Four speeds and a neutral position are provided and an H-shift lever forms a convenient means of control. Power is taken from the gear box to the vertical ram by means of a large slotted eccentric and follower block which produce the slow power stroke and the quick return motion.

The ram slide and ram form a separate unit on the front of the column. The slide is hinged at the top and has a screw adjustment at the bottom, so that the entire unit may be swung to any angle up to five deg. and locked in position. An angular scale is provided to facilitate setting the ram, and a new feature has been added which permits it to be returned to the true vertical position without additional adjustment. The vertical position of the ram on its slide is obtained by a crank which operates a vertical screw and positioning nut through a pair of bevel gears. The length of stroke of the ram is variable from 0 to 6½ in. by means of an adjustment on the end of the feed cam. The four speeds obtained from the gear box produce ram speeds of 33, 49, 76 and 116 strokes per minute.

The tool head is of a new design, to increase the usefulness of the shaper. The tool post is carried in a clapper mounted so that the thrust of the cut forces it rigidly against the head. This clapper permits the tool to clear the work on the return stroke, thereby prolonging the life of the cutting edge. Attention is called to the elimination of the tool post binder screw, the tool being held by drawing the tool post against it from the back. This feature permits the tool post to pass over the work. The tool head may be rotated a full 360 deg., and solidly clamped in position. This feature further increases the range of work to which the machine is applicable, and makes the setting up of the work much less complicated.

The 19¾-in. rotary table, which is an outstanding feature of the shaper, is provided with 12 indexing notches so that quick indexing may be had for ½, ⅓, ¼, 1/6 and 1/12 of a complete circle. Power feeds for both the longitudinal and transverse slides are regular equipment with the shaper and these feeds are controlled by slip gears. Rotary power feed to the circular table may be furnished.

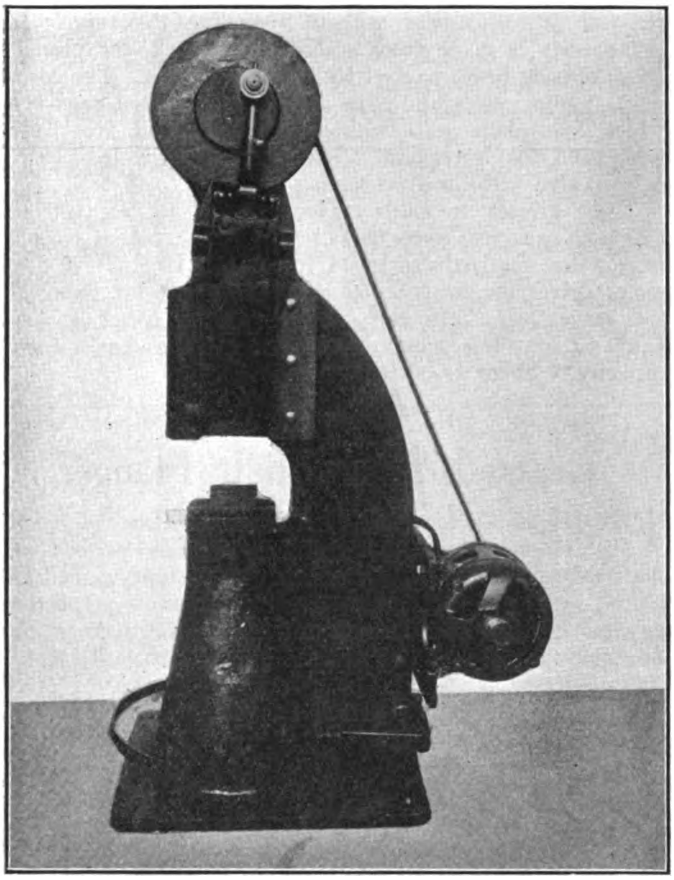
The distance from the table top to the under side of the ram bearing is 10½ in. and the maximum distance between the table and the ram is 15 in. The floor space occupied by the shaper is 53 in. by 68¼ in. and the overall height is 83¾ in. The machine with regular equipment weighs about 4,550 lb.



Vertical Shaper Provided with a Selective Gear Ram Drive and a Rotary Table with 12 Indexing Notches

Self-Contained Utility Hammer

THE Beaudry Company, Inc., Everett, Mass., is now marketing a low-priced utility hammer especially suitable as a general service tool for shops where there is not enough blacksmith work to warrant a large investment in a power hammer. These machines are built in three sizes in which the weights of the rams are 25, 50 and 100 lb. respectively. They are cast in one piece and require no extensive foundation.



Beaudry Utility Hammer Provided with an Off-set Anvil

The ram or hammer head is of steel and runs in external elliptical-shaped tracks. Two steel spring arms with steel rollers at the lower end and a helical spring at the top, operate on the curved tracks which lift and throw the ram, which, with an increased speed of the hammer acquires increased travel and force of blow. The full stroke can be had on varying thicknesses of stock and no change of adjustment is necessary excepting for unusually heavy or special work. The hammer has an exceptionally long stroke and may be operated at a very high rate of speed.

The hammer is started, stopped and regulated by a foot treadle extending around the base of the machine. The treadle throws in or out a cone clutch fitted in the hammer pulley and clutch surfaces which are fitted with a brake lining. The ram is carefully machined and fitted to heavy V-shaped guides and is adjustable on its connecting rod for varying heights above the dies. It has an adjustable taper gib for taking up wear. These hammers may be worked to equal advantage from all sides, as the anvil is offset, clearing the main frame casting, which allows bars of any length to be worked either way.

As regularly furnished these hammers may be operated by an overhead belt running at any angle or by a motor attached to the frame as shown. They may be turned into a motor-drive at any time without any mechanical change except for the bolting on of the motor bracket and the attaching of the motor to it.

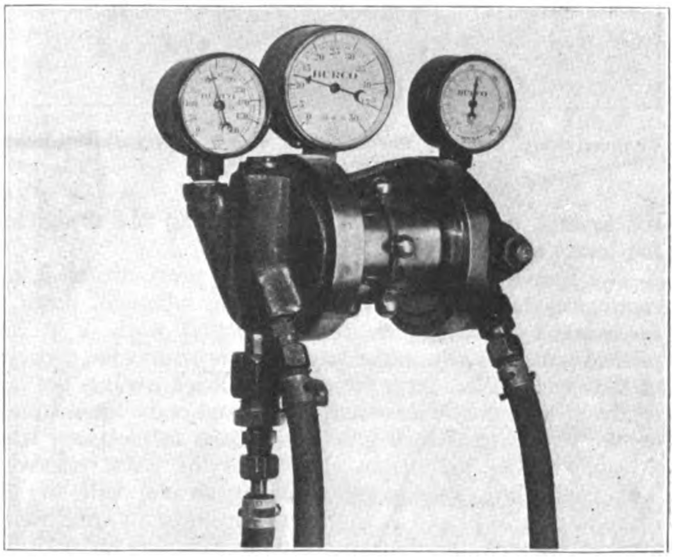
Some of the principle specifications of the largest size hammer are as follows: length of stroke 10 in.; maximum size of stock worked 3 sq. in.; number of blows per minute 300; size of dies 2½ in. by 5 in.; height over all 60 in.; size of motor 3 hp.

Automatic Equal Pressures Two Gas Regulator

WITH the idea of promoting safety in the use of oxy-acetylene cutting and welding equipment, the Burdett Oxygen & Hydrogen Co., Chicago, has developed the automatic, equal pressures, two gas regulator illustrated. There are three connections to this regulator as indicated, that on the left being the acetylene tank connection, the middle the acetylene torch hose and the right the oxygen torch hose. By means of this regulator with a single adjusting wheel, equal pressures can be produced in the oxygen and acetylene hose lines leading from the regulator to the torch. The regulator is designed to prevent mixed gases in either hose length by producing equal pressures automatically, thus preventing hose fires, hose explosions, the burning out of regulator seats and the possibility of regulator explosions from flame propagation. Moreover, uniform gas pressures delivered to the torch have a tendency to produce a more tenacious and well balanced flame.

The single hand wheel controlling both gases in one regulator makes unnecessary numerous adjustments and re-adjustments of independent regulators on the oxygen and acetylene tanks. The center gage shows the torch pressure readings for both gases. The two gases flow independently until after they pass the valves in the torch and reach the point of mixture either in the handle or in the head, or in the tips.

The hand wheel when turned with an upward motion brings an equal pressure on the two controlling diaphragms

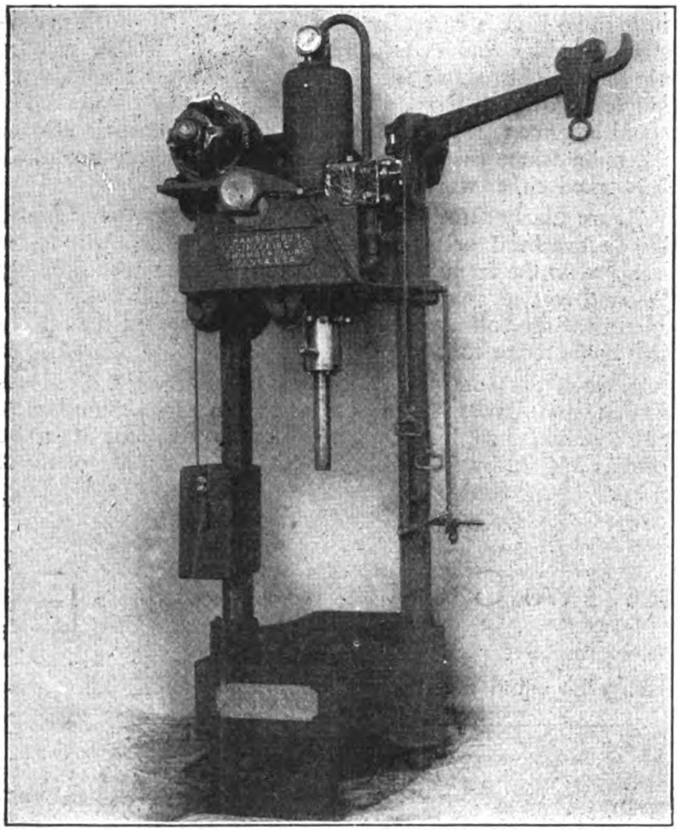


Burco Two Gas Regulator Which Maintains Equal Torch Hose Pressures Automatically

by the compression of a single spring. The thrust of the hand wheel is against ball bearings which reduce the force necessary to turn the control to a minimum. Unequal oxygen and acetylene tank pressures are controlled by the gas flow areas and resistance. The regulator is designed to give ample volume of both gases for welding operations at all times. It is possible also to use this regulator for cutting when the oxygen pressure required is not greater than 40 lb. This is said to make it possible to cut steel billets up to three inches thick with a modern Burco cutting or combination torch.

Hydro-Pneumatic Bushing Press

A LINE of Model B forcing and bending presses, designed to provide a machine capable of filling the exacting requirements of the railroad shop, has recently been developed by the Chambersburg Engineering Company, Chambersburg, Pa. These presses may be used for such work as inserting and removing locomotive driving



Chambersburg Bushing Press Provided with a Hydro-Pneumatic Operated Ram

rod brasses, bushings, link hangers, bending and straightening levers and connecting rods, etc.

The hydro-pneumatic feature of the press makes it exceptionally fast in operation. The ram is brought down to the work by air pressure and the actual work is accomplished hydraulically under any pressure within the capacity of the machine. A large weighted pullback assures the fast return of the ram. The motor, pump, and crane are mounted on the top platen which gives free access to the press from all sides. The top platen also forms the water reservoir. The controlling valves are mounted on the side of the machine and so placed as to give the operator an unrestricted view of the work and the gages without changing his position.

The platens are made from heavy semi-steel castings. The base platen is provided with an 8-in. hole in the center to allow the work to go through. It can be changed to suit individual requirements. The cylinder is made from an open-hearth steel casting and is inserted in the upper platen.

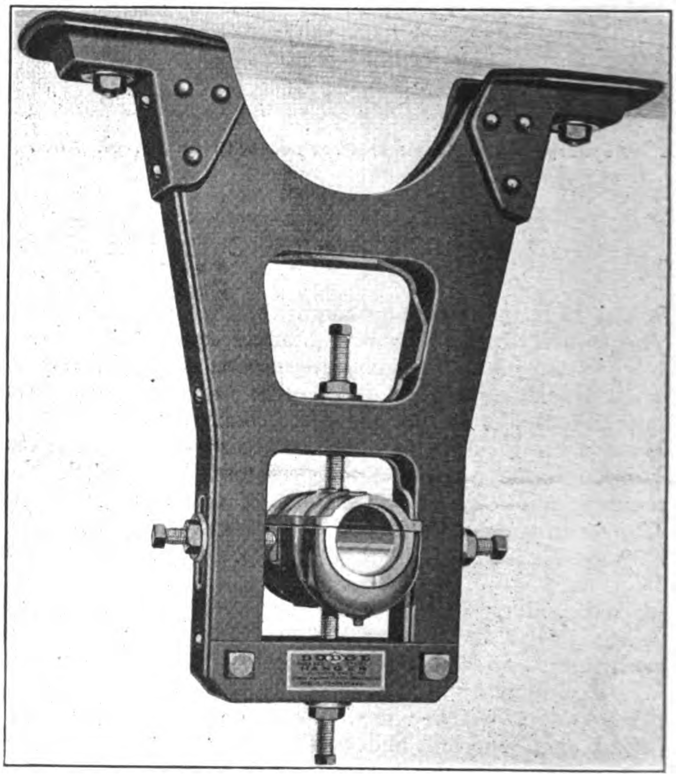
The ram is cast of air furnace iron and turned and finished under a rolling process, which is said to give long life to the packing and prevent corrosion. It is outside packed with an improved U-leather, which permits ready renewal or adjustment without removing the ram. The pump body is made from a solid steel block, the plungers being outside hemp packed with bronze glands. The Monel metal pump valves and seats are of the inverted cage type, which hold their seats without threading and are readily removable for inspection. The press is provided with a safety valve with an overload trip.

These presses are built in four sizes: 50, 75, 100 and 125 tons capacity, respectively. The stroke ranges from 13 in. on the smallest size to 24 in. on the largest. A 5-hp. motor drives the two smaller sizes and a 7½-hp. motor the two larger sizes. In each case the motor speed is about 1,000 r.p.m. The standard crane on all sizes has a lifting capacity of about 1,000 lb.

Pressed Steel Shaft Hanger

THE Dodge Manufacturing Corporation, Mishawaka, Ind., has recently put on the market an improved pressed-steel shaft hanger. The frame is of box construction, welded and riveted together. A malleable iron foot of ample proportions provides a broad, solid bearing and extends downward a considerable distance on the frame, which contributes to the rigidity of the hanger.

The shaft bearing is of the four-point suspension type.



Pressed Steel Four-Point Set Screw Type Shaft Hanger

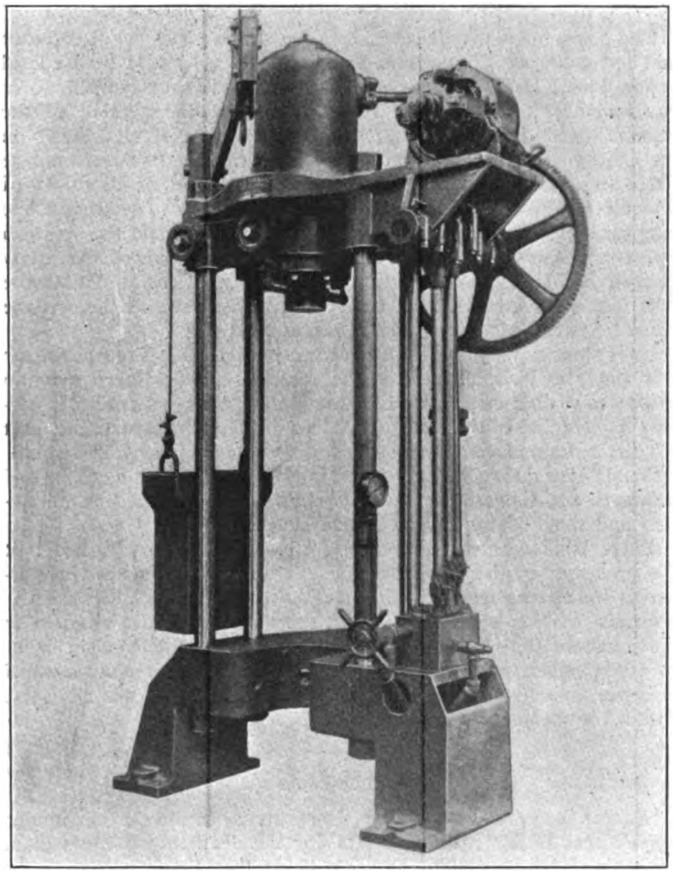
It is firmly held in place by four oil-tempered setscrews, which are provided with a washer and lock nut. The bearing may be moved in any direction, owing to the fact that the setscrews can be moved in rectangular slots which are cut out in the frame of the hanger. The bearing is provided for

either ring or capillary oilers. The rings may be removed and capillary blocks substituted, or vice versa, if desired. The hanger is finished with a special paint containing varnish.

Rapid Action Hydraulic Bushing Press

THE Southwark Foundry and Machine Company, Philadelphia, Pa., has recently placed on the market a rapid action hydraulic bushing press. It is of the four-column type and obtains its rapid action without the need of auxiliary equipment, such as racks or compressed air connections.

The rapid movement of the ram is obtained by means of a triplex pump. Two of the plungers of this pump are of small diameter for high pressure, while the third plunger is of larger diameter, which pumps a large volume of water. In operation, the ram is brought rapidly down to the work by means of the large volume of water pumped into the cylinder by the low pressure plunger. As soon as the ram comes in contact with the work, pressure is built up in the cylinder, and this plunger automatically cuts out from the cylinder and discharges into the slack water tank. The pressure for doing the actual work is then carried on by means of the two high pressure plungers. After the operation is completed the ram is returned to its starting point by means of a counter balanced weight.



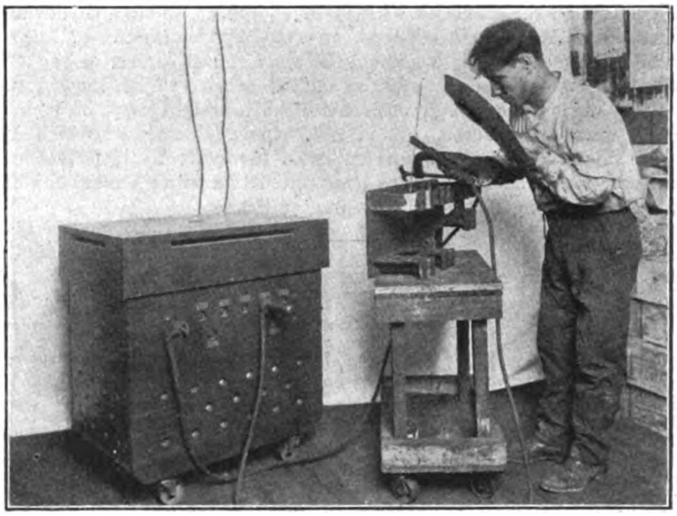
Southwark Hydraulic Bushing Press Equipped with a High and Low Pressure Triplex Pump

The bottom platen or work table has the slack water tank as an integral part of it. This platen can be furnished in several other designs from the one shown, to suit special work. The machines are equipped with an overhead crane for a chain hoist which will handle work on both sides of the press. The presses can be furnished in capacities ranging from 30 to 200 tons. The machine is entirely self-contained and only needs to have the motor connected and the slack water tank filled in order to be ready for service.

The Walters Electric Arc Welder

A READILY portable arc welding machine has been brought out by the Walters Arc Welding Corporation, New York. The machine is enclosed in a wooden box mounted on castors which makes it readily portable. The welding points are marked directly in amperes on the outside of the casing. This positive marking tends to insure against using the wrong amperage for different materials to be welded.

The maximum and minimum welding currents are 200 and 40 amperes respectively. The machine is, therefore, said to be capable of welding any job, without pre-heating, in cast and malleable iron or steel, from a locomotive frame to a No. 14 gage cab sheet. It is built on the transformer principle so that it will operate on single phase, two phase or three phase current, using 220, 440 and 550 volts, respectively. This makes it very convenient for railroad work. The danger from electric shock is reduced to a minimum as only asbestos covered wire is used throughout.



Portable Electric Arc Welder Especially Adapted to Railway Practice

The cooling is accomplished by natural ventilation thus eliminating the necessity of a fan. The machine is capable of standing continuous welding at 200 amperes. The current regulation is very close. On short circuit the welding current shows only 10 amperes higher than while the arc is in operation.

THE RAILWAY AND LOCOMOTIVE HISTORICAL SOCIETY has issued its eighth bulletin, a pamphlet of 87 pages, containing, as usual, an interesting variety of information about old locomotives, particularly those of New England. A descriptive list of locomotives of the Old Colony Railroad fills 33 pages. There is a picture of "Locomotive No. 1," the pioneer locomotive of the Stockton & Darlington, which for many years has stood on a pedestal at the Northeastern railroad station in Darlington (England). It is stated that this locomotive, which began its career in 1825 and was taken out of service in 1841, has been sent away from its home a half dozen times, going to various exhibitions, including that at Philadelphia, in 1876, and the British Empire exhibition of the present year.

GENERAL NEWS

Fuel Consumption on the M-K-T—a Correction

In the item on fuel consumption published in the November *Railway Mechanical Engineer*, page 710, the record was credited in error to the Missouri Pacific, whereas it belonged to the Missouri-Kansas-Tex.

Labor News

Wage increases of from two to five cents an hour have been awarded by the Missouri-Kansas-Texas to its shopmen in several classifications.

An agreement whereby shut-downs in the western line shops of the Canadian Pacific were not to exceed two days in November nor three days in December and the following months, was made at a recent conference between officers in charge of the rolling stock on the western lines and representatives of the Federated Shop Crafts.

Locomotive Inspection Report of the I. C. C.

The Interstate Commerce Commission's monthly report to the President on the condition of railway equipment shows that during October, 5,898 locomotives were inspected by the Bureau of Locomotive Inspection, of which 2,847 were found defective, or 48 per cent, and 341 were ordered out of service. The Bureau of Safety during the month inspected 104,515 freight cars, of which 4,347 were found defective, and 1,413 passenger cars, of which 23 were found defective. Fourteen cases involving 33 violations of the safety appliance acts were transmitted to various United States attorneys during the month for prosecution.

Passenger Cars Ordered, Installed, Retired

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter	No. under order or being constructed
Jan.-March	792	679	54,370	1,586
April-June	513	555	54,328	1,450
July-Sept.	553	531	54,349	1,231
Oct.-Dec.	861	948	54,262	832
Full year, 1923	2,719	2,713	.....	....
1924				
Jan.-March	699	431	54,519	970
April-June	698	552	54,668	847
July-Sept.	668	544	54,783	791

Figures in remaining columns from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55A. Figures cover only Class I roads reporting to Car Service Division.

Pullman Company Keeps Its Shops Clean

The Pullman Car & Manufacturing Company has adopted a novel idea to further its clean-up campaign for eliminating waste materials and rubbish in the various departments and keeping the premises in a clean and orderly condition. In addition to awarding a banner to each department wherein the premises are clean and orderly, a committee designates the dirtiest place in the plant, and a large sign is set up at that place. The sign cannot be moved until the department is made clean and placed in good order.

The plan was first tried at the Michigan City (Ind.) shops in July, 1923, with a sign reading: "This is the Dirtiest Place in the Plant." The psychology of the sign was so effective that it has been impossible to award the sign to that or any other department since that time.

New Pullman Cars for the Merchants Limited on the New Haven

A decorative scheme designed to make the interior of a railroad car as bright and pleasant as a living room in one of the finer homes has been adopted in designing the new equipment which was recently placed in service on the Merchants Limited of the New York, New Haven & Hartford, an extra fare train running between Boston and New York. The trimmings of the cars are done in cream colored enamel. The revolving chairs are of an entirely new design and are upholstered in a lighter shade of fabric than is ordinarily used on Pullman cars, so as to harmonize with the general scheme. The window curtains are silk faced, and the carpets are made of materials to be in harmony with the whole.

Twelve of the new cars have been received from the Pullman Company. The chairs have been arranged so as to be opposite a separate window. Other features are a new decorative grill over the steam pipes, an improved ventilating system, and a newly designed ladies' retiring room which is distinctly more commodious and affords greater privacy.

Labor Board's Powers Upheld

The power of the Railroad Labor Board to compel the attendance and testimony of witnesses at its hearings was upheld by Federal Judge James H. Wilkerson at Chicago in a decision handed down on November 6. The court refused to quash the petition of the Labor Board demanding that J. McGuire, general chairman, on the Chicago & North Western, of the Brotherhood of Locomotive Engineers, and D. B. Robertson, president of the Brotherhood of Locomotive Firemen & Enginemen, be compelled to testify in the long pending wage dispute between the enginemen and the western railways. Immediately after the decision was announced, Attorney Donald Richberg, representing the brotherhoods, declared that the case would be appealed and would eventually be taken before the United States Supreme Court if necessary.

In his decision, Judge Wilkerson says that the Transportation Act states in plain terms that the Railroad Labor Board may go before any district court with complaints against stubborn witnesses. He holds that the provisions in the Transportation Act for the enforcement of subpœnas of the Labor Board are constitutional. He quotes numerous precedents to sustain his ruling and refers to the Clayton Act and the Interstate Commerce Commission and the Federal Trade Commission laws.

Judge Wilkerson declared that it is now "firmly established that the processes of the court may be exercised in aid of an investigation by administrative bodies. It does not follow, because the decisions of the board are not enforceable under the statutes in the courts of the United States, and are merely published in order to guide public opinion, that the proceedings in court to compel evidence on which to place the findings of the board are advisory, within the means of the cases cited."

Court News

Squeaking Air-Pump Not Defective.—In an action under the Federal Boiler Inspection Act for the death of an engineman, the New York Appellate Division holds that the burden was on the plaintiff to prove that the appurtenances of the locomotive were in proper condition and safe to operate in the service to which it is put, and also the railroad's failure to keep them in such condition. The fact that the air pump squeaked and groaned was not a defect, but a condition requiring lubrication by the engineman. The statute does not require a perfect but only a proper condition, and a different standard might govern a locomotive engaged in yard service, or one put to another service.—Luce v. N. Y. C. & St. L., 205 N. Y. Supp. 273.

Decisions Under Federal Employers' Liability Act.—The New York Appellate Division holds that an employee, engaged in repairing a locomotive used wholly within the state both for interstate and intrastate traffic, withdrawn from service and in the enginehouse repair shop for five days, the repairs consisting in repairing worn tires, was not engaged in interstate commerce.—Conklin v. N. Y. C., 206 App. Div. 524, 202 N. Y. Supp. 75.

The Circuit Court of Appeals holds that a machinist and his helper, engaged in making, in an enginehouse, the usual running

repairs on a locomotive engaged in interstate commerce, on the lay-over period between trips, the locomotive not being withdrawn from interstate commerce for the purpose of making the repairs, were engaged in interstate commerce.

Although the helper, when injured, had discontinued his work and was bound for lunch, he was still engaged in interstate commerce within the act.—B. & O. v. Kast, 299 Fed. 419.

The New York Court of Appeals holds that a railroad employee, killed by electric shock when oiling an electric crane in the railroad shop, the crane being partly used to repair locomotives and cars engaged in interstate commerce, was not within the act.—Tepper v. N. Y., N. H. & H., 238 N. Y. 423, 144 N. E. 668.

MEETINGS AND CONVENTIONS

The American Society for Testing Materials has selected the Chalfonte-Haddon Hall, Atlantic City, N. J., as the headquarters for its next annual meeting, which will be held on June 22-26.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room, 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMAN'S ASSOCIATION.—G. G. Macina, 11402 Calumet ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Railroad Division, A. F. Steubing, Bradford Corp., 23 West Forty-third street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting December 9. Paper on Railroad Location will be presented by G. S. Gyowski, chief engineer of construction, Canadian National.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Next meeting December 10. Paper on Terminal Operation will be presented by R. L. Scott, trainmaster, New York Central.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMAN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting December 11. A paper on Ancient Trails and Modern Highways will be presented by W. L. Lanigan, general freight traffic manager, Canadian Pacific.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Next meeting December 19. Annual dinner. Dr. David Friday will be the speaker.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August. Next meeting December 5. Paper on "The Ice Age" will be presented by F. R. Layng, engineer of terminals, Bessemer & Lake Erie.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting December 12. A paper on the Development of Transportation will be presented by Col. F. G. Jonah, assistant to president and chief engineer, St. Louis-San Francisco.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The New York City office of the Joyce-Cridland Company is now at 105 West Fortieth street. Arthur S. Beattys is eastern sales manager.

The National Malleable & Steel Castings Company, Cleveland, Ohio, is constructing an annealing plant, 100 ft. by 500 ft., in Indianapolis, Ind.

The Economy Electric Devices Company, Chicago, has been appointed central western sales representative of the Chausse Oil Burner Company.

W. G. Cook has been appointed manager of packing sales, Chicago branch of the United States Rubber Company, with headquarters at Chicago.

J. D. Purdy, who has been chief draftsman of the Pilliod Company for many years at Swanton, Ohio, has been appointed mechanical engineer, with office at the same location.

The Sullivan Machinery Company, Chicago, has established a branch office and warehouse in Los Angeles, Cal., at 442 East Third street. Benjamin P. Lane is the local manager.

E. T. Wade has been appointed representative in the southern territory for the Franklin Railway Oil Company, Franklin, Pa. Mr. Wade's headquarters are at 1125 Mutual building, Richmond, Va.

Frederick E. Bausch, 1105 Chemical building, St. Louis, Mo., has been appointed district representative in eastern Missouri and southern Illinois, of the Conveyors Corporation of America, Chicago.

T. B. H. Askin has been appointed sales manager for the inter-mountain division of the American Manganese Steel Company, Inc. Mr. Askin's headquarters are at Denver, Colo.

The Premier Staybolt Company, Pittsburgh, Pa., has opened a Chicago office in the Peoples Trust & Bank building, 30 North Michigan boulevard. L. W. Widmeier, assistant to the president, is in charge of this office.

H. V. Beronius has been appointed representative in Iowa, Kansas, Nebraska, Oklahoma and Northwestern Missouri, with headquarters at 33 Linwood Terrace, Kansas City, Mo., for the Gibb Welding Machine Company, Bay City, Mich.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, in following out a program of improvement in the production of hollow staybolt iron, has installed a new automatic mill which eliminates considerable manual labor and controls the evolution of the bar automatically.

W. R. Hans, who has been in the service of the Whiting Corporation, Harvey, Ill., for a number of years, has been placed in charge of a new district sales office opened by that company at 997 Ellicott square building, Buffalo, N. Y., to succeed its former agent, George F. Crivel & Co., Buffalo.

G. E. Emmons, vice-president in charge of manufacturing of the General Electric Company, Schenectady, N. Y., who has been identified with the electrical industry since 1886, has been relieved of the responsibilities of his position and is planning to move from Schenectady to Pasadena, Cal.

Tom Moore, 811 Royster building, Norfolk, Va., has been appointed railroad sales agent in the southeastern district for the American Bolt Corporation, New York. He will conduct the sales activities in the railroad and industrial field. Mr. Moore was formerly general purchasing agent of the Virginian railway.

The Milburn Sales Company, distributors for the Alexander Milburn Company, manufacturers of oxy-acetylene welding and cutting apparatus and portable carbide lights, have taken over the Metropolitan New York district, with headquarters at 309 Fifth avenue. E. P. Boyer, D. Keyser and other assistants will be in charge of the new agency.

N. P. Farrar, district manager of the Philadelphia territory for the Pawling & Harnischfeger Company, Milwaukee, Wis., has been appointed assistant sales manager. H. L. Mode has been

appointed sales representative in the eastern territory, with headquarters at New York and Philadelphia, Pa. Mr. Mode was formerly in the motor department of the General Electric Company.

A. B. Cooper has been appointed sales manager in the Philadelphia district with office in the Widener building, for the Central Steel Company, Massillon, Ohio, makers of Agathon alloy steels. Mr. Cooper has been identified with the steel industry for 17 years in both operating and sales work. He was formerly with the Tacony Steel Company and the Penn Seaboard Steel Corporation in the Philadelphia territory.

R. C. Broach of Atlanta, Ga., and formerly in the general sales department at St. Louis, Mo., of the Heine Boiler Company, St. Louis, has been appointed this company's southeastern district manager with office at 709 Glenn building, Atlanta, Ga. The southeastern territory consists of eastern Tennessee, North and South Carolina, Alabama, Georgia and Florida. S. B. Alexander, Charlotte, N. C., will continue as the company's special representative in North and South Carolina.

E. A. Gregory, district sales manager of the American Brake Shoe & Foundry Company, with headquarters at Houston, Texas, died on November 1, in a hospital in New York. Mr. Gregory was born in Nashville, Tenn., on March 22, 1877. He entered railroad work in 1900 with the Nashville, Chattanooga & St. Louis and in 1903 was appointed foreman of terminals of the Louisville & Nashville, at Nashville, Tenn. He remained in that position until January, 1909, when he went with the American Brake Shoe & Foundry Company. On March 1, 1923, he was appointed district manager, with headquarters at Houston, Tex.

Charles S. Gawthrop, vice-president of the American Car & Foundry Export Company, died at his house in New York City, on October 31, after a short illness, from pneumonia. Mr. Gawthrop was born in Wilmington, Del., on November 21, 1868. After graduation from the University of Pennsylvania, in the class of 1888, he entered the employ of the Jackson & Sharp Company, railway car builders, at Wilmington. In 1901 when that company was acquired by the American Car & Foundry Company, Mr. Gawthrop became district manager of the Jackson & Sharp plant, which position he held until the formation of the American Car & Foundry Export Company in 1913. He then became a director and vice-president of the new corporation and continued in those offices until his death.

C. S. Gawthrop

The stockholders of Joseph T. Ryerson & Son, Inc., Chicago, have bought a substantial interest in the Reed-Smith Company at Nineteenth and South Canal streets, Milwaukee, Wis. The Reed-Smith Company is an independent steel warehousing company serving the industry in that section of the country. It has a large and varied line of finished steel products in stock, with facilities for quick shipment. The officers of the Reed-Smith Company of Milwaukee are now as follows: D. M. Ryerson, president; George W. Smith, vice-president and general manager; E. L. Hartig, treasurer and Carl Gallauer, secretary. Donald M. Ryerson is a vice-president of Joseph T. Ryerson & Son, Inc., with headquarters at Chicago. He is a grandson of the founder of Joseph T. Ryerson & Son, Inc., and his entire business career has been with that firm. G. W. Smith was formerly a partner of the Reed-Smith Company. E. L. Hartig is vice-president, secretary and treasurer in Chicago of Joseph T. Ryerson & Son, Inc., and Carl Gallauer was in charge of its Milwaukee office. The Milwaukee stocks and facilities of the Reed-Smith Company are to be increased, and in addition, Joseph T. Ryerson & Son, Inc., will maintain daily car service from Chicago for prompt delivery of special orders.

TRADE PUBLICATIONS

Door Operating Mechanism.—A four-page folder descriptive of the Type D door operating mechanism for hopper cars, has been issued by the Enterprise Railway Equipment Company, Chicago.

Packing for Booster Ball Joints.—The application of "V" Pilot packing to booster ball joints is described in a four-page illustrated bulletin issued by the Pilot Packing Company, Inc., Chicago.

Swaging Machines.—A 32-page booklet illustrating the modern art of swaging and swaging machines has been issued by the Torrington Company, Torrington, Conn. Dimensions and capacities of the Dayton swaging machines are also given.

Decarbonizing.—The operation and application of the Ehrhart decarbonizer, which prevents accumulation of carbon in the exhaust passages and eliminates existing carbon deposits, is described in a four-page folder issued by the Pilot Packing Company, Chicago.

Face Plate Jaws.—The Independent face plate jaw, XAP-2, designed to withstand the heavy strains of holding work on powerful machining units, is briefly described in a small six-page folder issued by the Bullard Machine Tool Company, Bridgeport, Conn.

Automatic Die-Cutting Machines.—The Keller Mechanical Engineering Corporation, Brooklyn, N. Y., has issued a four-page bulletin descriptive of its Types F, BG and E-5 automatic machines, on which milling, drilling and boring operations can be performed at one setting.

Power Reverse Gears.—The various parts entering into the construction of the Precision and Type E Ragonnet power reverse gears are listed and illustrated in Bulletins Nos. 232A and 230A, which have been published by the Franklin Railway Supply Company, Inc., New York.

Centrifugal Pumps.—Mather & Platt, Ltd., Manchester, England, has prepared a 20-page brochure descriptive of its hydraulic pressure pumps of the centrifugal or turbine type. Illustrations of typical hydraulic pressure installations in railway and other general industrial practices are shown.

Ash Conveyors.—An eight-page bulletin descriptive of the American high duty conveyor for handling ashes and cinders from large power plants, has been issued by the Conveyors Corporation of America, Chicago. The conveyor is built with a 9-in. conduit, through which the ashes pass.

Floor Operated Electric Hoists.—A 60-page catalogue descriptive of Shepard floor operated electric hoists has been issued by the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y. Each type of hoist is described in the following sequence: general description, installation view, portrait view, list prices, reference drawings and dimensions.

Engineering and Mechanical Literature.—A classified guide to the literature relating to the engineering and mechanical industries published between August 1, 1923, and July 31, 1924, is being distributed by F. & E. Stoneham, Ltd., London, E. C., England. This information was specially compiled for the annual conference of the Library Association, St. Andrew's Hall, Glasgow, Scotland.

Pipe Threading Equipment.—Piping and casing specifications, motor and special die information, shipping weights, dimensions, speeds, etc., of Oster pipe threading equipment, are given in a conveniently indexed catalogue, List No. 34, issued by the Oster Manufacturing Company, Cleveland, Ohio. Plain and ratchet die stocks, light hand machines with ratchets and power machines are featured in this 56-page catalogue.

Mechanical Equipment.—A five-page reprint, descriptive of its major products as shown in the 1924-25 volume of the A. S. M. E. condensed catalogues of mechanical equipment, has been issued by the Combustion Engineering Corporation, New York. The equipment illustrated includes the Lopulco and C-E direct fired systems of burning pulverized coal, the Frederick, Green, Coxe and other types of stokers, conveyors, etc.

Upset Forgings.—The American Forge Company, Chicago, has issued a 32-page pamphlet in which is described the origin, growth

and advantages of the methods used by that company in upsetting forgings. The contents contain considerable information relative to the application of AmForge upset methods in various industries and are well illustrated. There is a brief description of the method used in manufacturing knuckle pins according to standard M. C. B. specifications.

Models.—Interesting circulars illustrating typical miniature models of machines and mechanical appliances, ships, bridges, water works, entire factory and industrial plants, public buildings, towns, etc., have been issued by Peter Koch, Model Building Works, Ltd., Cologne-Nippes. These reduced representations correspond in detail to the full-size originals and are built especially for demonstration purposes at fairs or exhibitions, also for experimental or technical instruction.

Iron and Steel for Electrical Uses.—The history and manufacture of Armco electrical sheet steels and ingot iron is outlined in a 56-page, illustrated book issued by the American Rolling Mill Company, Middletown, Ohio. The book is divided into two sections. Part I describes the development of magnetic material and the magnetic properties and various uses of Armco electrical sheet steel grades. Part II describes the physical and electrical properties of Armco ingot iron and its uses.

File Chart.—A complete and ready reference to the various kinds, sizes, shapes and cuts of saw files, machinists' files, miscellaneous files and rasps and extra fine Swiss pattern files, has been prepared by the Nicholson File Company, Providence, R. I., in the form of a 54-in. by 27-in. hanger printed on heavy cloth-backed paper, with wood rollers at top and bottom. The chart is also printed on 27-in. by 12-in. cards, the surfaces of both styles being varnished to permit of washing.

Stokers.—Catalogue E-5, illustrating and describing the Type E single retort underfeed stoker and its principal parts, has been issued by the Combustion Engineering Corporation, New York. The results of typical evaporative tests of Type E stokers are given in tabulated form, and a curve shows the efficiency of the stokers at various boiler ratings, using a good grade of bituminous coal. Representative Type E stoker installations and other products of the Combustion Engineering Corporation are also listed.

Welding Electrode.—A 12-page booklet issued by the General Electric Company, Schenectady, N. Y., and bearing the designation Y-2019, describes the new Type A General Electric welding electrode. Details are given on electrode construction and characteristics. Results of tests on welded cast iron specimens and deposited metal specimens are described, and oscillograms demonstrating arc stability are reproduced. Instructions for the use of the electrode are supplied and specifications of the standard sizes given.

Mechanical Stokers.—"The Condensed Catalogue of Mechanical Stokers," conceived as an important step in putting before the industrial world the breadth of service performed by mechanical stokers and the engineering organizations behind them, has just been issued by the Stoker Manufacturers' Association, Detroit, Mich. A brief, but complete engineering description of all prominent makes of mechanical stokers is presented in the book, which is a co-operative catalogue of mechanical equipment of competitive manufacturers.

Grinding Wheel Selection.—"Factors Affecting Grinding Wheel Selection" is the title of a 24-page brochure recently issued by the Norton Company, Worcester, Mass. The booklet is divided into two parts, the first part outlining for the shop superintendent, methods engineer, foreman or workman the factors involved in selecting a grinding wheel for a certain job. The second part contains a table of grinding wheel recommendations which lists many of the common grinding operations, the grain and grade of wheels to be tried first, the usual range of wheels, etc.

Air Brake Equipment for Gasoline-Driven Rail Cars.—Rules intended to cover in a condensed form the important instructions to be observed in the operation of SME brake equipment, designed for use on single gasoline-driven rail cars or on trains composed of one motor car and one trailer car, and a complete description of its construction and operation, are given in a 53-page instruction pamphlet, No. 5056, issued by the Automotive Division of the Westinghouse Air Brake Company, Pittsburgh, Pa. Simple diagrammatic charts show the connections which are made between the various ports and passages of the respective devices.

PERSONAL MENTION

General

B. M. Brown, superintendent of motive power and equipment of the Southern Pacific Louisiana lines at Algiers, La., has been promoted to chief assistant superintendent of motive power of the lines in Texas and Louisiana, with headquarters at Houston, Tex., succeeding R. U. Lipscomb.

R. U. Lipscomb, assistant superintendent of motive power of the Southern Pacific lines in Texas and Louisiana, has been promoted to superintendent of motive power of the new Eastern district, formed by the lease of the El Paso & Southwestern to the Southern Pacific, with headquarters at El Paso, Tex. Mr. Lipscomb was born on March 5, 1873, at Brenham, Texas. He entered railway service as a messenger boy on the Southern Pacific at San Antonio, Tex., on January 1, 1889, and later served as shop clerk, time keeper and machinist apprentice. After completing his apprenticeship he was employed as a machinist until 1905 when he was promoted to machine shop foreman at San Antonio. Mr. Lipscomb was promoted to general foreman in 1912 and held that position until 1916 when he was promoted to assistant mechanical superintendent of the El Paso division. In 1919 he was promoted to chief assistant superintendent of motive power and equipment of the Texas & Louisiana lines, with headquarters at Houston, Tex.

Thomas Paxton, superintendent of motive power of the El Paso & Southwestern, with headquarters at El Paso, Tex., has retired. Mr. Paxton was born on January 30, 1855, in Hampshire county, Virginia, and entered railway service in 1873 as a machinist apprentice of the Baltimore & Ohio. From September, 1879, to April, 1884, he was employed as a machinist on the Texas & Pacific; the St. Louis, Iron Mountain & Southern, now a part of the Missouri Pacific; the Pennsylvania and the Wabash. He was appointed roundhouse foreman of the Atchison, Topeka & Santa Fe in April, 1884, and held that position until April, 1889, when he was promoted to master mechanic of the Argentine terminal. Mr. Paxton was transferred to the Middle division in September, 1889, and continued in that capacity until February, 1897, when he was transferred to the Chicago division. He was promoted to general master mechanic of the Texas lines in February, 1901, and in February of the following year, was appointed superintendent of motive power of the Colorado & Southern. Mr. Paxton was appointed master mechanic of the Central division of the St. Louis-San Francisco in April, 1903. In February, 1904, he was appointed master mechanic at the Baring Cross shops of the Missouri Pacific at Little Rock, Ark., and held that position until August, 1904, when he was appointed master mechanic of the El Paso & Southwestern. He was promoted to superintendent of motive power on June 1, 1905, in which position he remained until his recent retirement.

Master Mechanics and Road Foremen

S. L. Mider, assistant road foreman of engines of the Cincinnati division of the Pennsylvania, has retired.

J. G. Swartz has been promoted to assistant road foreman of engines of the Cincinnati division of the Pennsylvania.

W. G. Reid has been appointed master mechanic of the Rio Grande division of the Southern Pacific, with headquarters at El Paso, Tex.

A. G. Newell has been appointed road foreman of engines of the Rio Grande division of the Southern Pacific, with headquarters at El Paso, Tex.

M. L. Hull has been appointed road foreman of engines of the New Mexico division of the Southern Pacific, with headquarters at Tucumcari, N. M.

John B. Icsman has been appointed master mechanic of the Lehigh & Hudson River, with headquarters at Warwick, N. Y., succeeding R. T. Jaynes, deceased.

G. H. Warning has been appointed master mechanic of the Saskatchewan district of the Canadian National, with headquarters at Regina, Sask., succeeding H. R. Simpson, deceased.

EUGENE GORDON has been appointed master mechanic of the New Mexico division of the Southern Pacific railroad, with headquarters at Tucumcari, N. M. Mr. Gordon was born on January 19, 1864, at Point Arena, Cal. He entered the employ of the Union Pacific as a locomotive fireman in November, 1887, and was later promoted to engineman on the same road. From May, 1896, to August, 1896, he served as an engineman on the Charleston & Savannah, a subsidiary of the Plant System. From October, 1896, to July, 1901, Mr. Gordon was successively employed as engineman, road foreman and division foreman of the Mexican Central. Leaving the employ of the Mexican Central, he was appointed an engineman on the El Paso & South Western, later holding the positions of traveling engineman, division foreman and master mechanic. He remained in the latter position until his appointment as noted above.

E. Gordon

CLARENCE F. PARKER, whose appointment as master mechanic of the Kansas City Southern with headquarters at Heavener, Okla., was announced in the November issue of the *Railway Mechanical Engineer,* was born on September 1, 1881, at Mineral Springs, Ark. Mr. Parker attended the Henderson Academy at Mena, Kans., and in 1905 he took special night courses at the Pittsburg High School and the Kansas State Teachers College. In July, 1898, he entered the employ of the Kansas City, Pittsburg & Gulf, now the Kansas City Southern, as a call boy at Mena. Later he worked as a machinist, in March, 1905, being transferred to Pittsburg, Kan., where he finished his apprenticeship as a machinist. In April, 1919, he was promoted to assistant roundhouse foreman and four months later he became night roundhouse foreman; in October, 1920, assistant roundhouse foreman, and in January, 1921, general roundhouse foreman.

C. F. Parker

Car Department

C. O. KEAGY, general foreman of the Meadows shops of the Pennsylvania, has been transferred as general car foreman to Wilmington, Del., succeeding F. W. Anderson.

E. E. ARNOLD, general car inspector of the Southern district of the Missouri Pacific, with headquarters at Little Rock, Ark., has been appointed superintendent of the De Soto, Mo., shops.

F. W. ANDERSON, general car foreman of the Maryland division of the Pennsylvania, at Wilmington, Del., has been appointed general foreman of the Pittsburgh division, with headquarters at Pitcairn, Pa. The position of general foreman, Ebenezer shop, Buffalo, N. Y., has been abolished.

Shop and Enginehouse

L. J. BALLARD has been appointed night roundhouse foreman of the Missouri-Kansas-Texas, with headquarters at Dallas, Tex., succeeding F. H. Brown.

J. R. WHEARY has been appointed general foreman of the Norfolk & Western, with headquarters at Crewe, Va., succeeding J. W. Hendricks, transferred.

C. A. REINHARD has been appointed general foreman of the Norfolk & Western, with headquarters at Williamson, W. Va., succeeding J. R. Wheary, transferred.

F. H. BROWN, night roundhouse foreman of the Missouri-Kansas-Texas, at Dallas, Tex., has been promoted to general foreman, with headquarters at Denison, Tex.

JOHN T. BUTLER, assistant erecting foreman of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed erecting foreman, succeeding E. A. Koschinske.

ROBERT FISHER, boiler foreman of the Terre Haute division of the Chicago, Milwaukee & St. Paul, has been promoted to general boiler foreman, with headquarters at Miles City, Mont.

GEORGE ALLEN, machinist and machinery inspector of the Illinois Central at Jackson, Tenn., has been promoted to night roundhouse foreman, with the same headquarters.

R. W. WILCOX, who has been in the employ of the Illinois Central since 1890, has been promoted to general foreman of the shops and roundhouse at Jackson, Tenn., Mr. Wilcox started as machinist in the Paducah, Ky., shops, where he advanced steadily. About ten years ago he was appointed day roundhouse foreman at Jackson.

Purchasing and Stores

JAMES E. KILBORN, purchasing agent of the Rutland, with headquarters at Rutland, Vt., has resigned.

R. C. ARNOLL has been appointed purchasing agent of the Rutland, with headquarters at Rutland, Vt., succeeding J. E. Kilborn, resigned.

L. G. PEARSON, general storekeeper of the El Paso & Southwestern, has been appointed district storekeeper of the new Eastern district of the Southern Pacific, with headquarters at El Paso, Tex.

G. T. RICHARDS, assistant district storekeeper of the Chicago, Milwaukee & St. Paul at Dubuque, Iowa, has been promoted to district storekeeper of the Southern district, with the same headquarters, succeeding J. E. Dexter, deceased.

Obituary

MAHAM H. HAIG, master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., died from pneumonia on November 10. Mr. Haig was born on July 9, 1878, at Charleston, S. C., and was graduated from Cornell university in 1900. He entered railway service in July of that year as a machinist apprentice on the Illinois Central and later served as a machinist and foreman for the same company. In April, 1906, he resigned to become editor of the Railway Master Mechanic and in February, 1909, re-entered railway service to become betterment assistant for the Atchison, Topeka & Santa Fe, where he was engaged in the betterment work of the bonus department. Mr. Haig later entered the motive power department and on December 1, 1909, he was promoted to mechanical engineer, with headquarters at Topeka, Kans. During the latter part of 1921 he was appointed master mechanic of the Pecos division.

M. H. Haig

R. T. JAYNES, master mechanic of the Lehigh & Hudson River, died at Warwick, N. Y., on November 4. Mr. Jaynes, who was born in 1865, began his railroad career as an apprentice in the shops of the Erie at Susquehanna, Pa. He subsequently worked for various railroads, entering the employ of the Lehigh & Hudson River in 1895 as general foreman.